1.1. D750V3 Dipole Calibration Certificate

| Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurict | y of | S C S | Schweizerischer Kalibrierdie Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service |
|---|---|--|---|
| Accredited by the Swiss Accredita The Swiss Accreditation Service Multilateral Agreement for the re | e is one of the signatorie | s to the EA | creditation No.: SCS 0108 |
| Client CCIC-HTW (Au | - | | : D750V3-1180_Feb1 |
| CALIBRATION C | ERTIFICATE | | |
| Object | D750V3 - SN:118 | 80 | |
| Calibration procedure(s) | QA CAL-05.v9 Calibration proce | dure for dipole validation kits abo | ove 700 MHz |
| Calibration date: | February 07, 201 | 8 | |
| The measurements and the unce | rtainties with confidence p | ional standards, which realize the physical un probability are given on the following pages ar any facility: environment temperature $(22 \pm 3)^{\circ 4}$ | nd are part of the certificate. |
| The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards | rtainties with confidence p cted in the closed laborato TE critical for calibration) | probability are given on the following pages ar any facility: environment temperature $(22 \pm 3)^{\circ (22)}$ Cal Date (Certificate No.) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration |
| The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP | rtainties with confidence p cted in the closed laborato TE critical for calibration) ID # SN: 104778 | Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-18 |
| The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 | rtainties with confidence p cted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 | Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521) | ad are part of the certificate. C and humidity < 70%. <u>Scheduled Calibration</u> Apr-18 Apr-18 |
| The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 | rtainties with confidence p cted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 | Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) | ad are part of the certificate. C and humidity < 70%. <u>Scheduled Calibration</u> Apr-18 Apr-18 Apr-18 Apr-18 |
| The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator | rtainties with confidence p cted in the closed laborato 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) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 04-Apr-17 (No. 217-02522) 04-Apr-17 (No. 217-02522) | ad are part of the certificate. C and humidity < 70%. <u>Scheduled Calibration</u> Apr-18 Apr-18 |
| The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 | rtainties with confidence p cted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) | Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) | ad are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 |
| The measurements and the unce All calibrations have been conduc 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 | rtainties with confidence p cted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 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. 217-02521) 04-Apr-17 (No. 217-02522) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) | Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 |
| The measurements and the unce All calibrations have been conduc 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 | rtainties with confidence p cted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103245 SN: 5058 (20k) 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. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) | ad are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Dec-18 Oct-18 Scheduled Check |
| The measurements and the unce All calibrations have been conduc 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 | rtainties with confidence p cted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 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. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-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) | ad are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 |
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| The measurements and the uncer All calibrations have been conduct 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 RF generator R&S SMT-06 | rtainties with confidence p cted in the closed laborato TE critical for calibration) 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 SN: US37390585 Name | Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 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) 18-Oct-01 (in house check Oct-17) | Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 |
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| The measurements and the uncer All calibrations have been conduct 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 RF generator R&S SMT-06 Network Analyzer HP 8753E | rtainties with confidence p cted in the closed laborato TE critical for calibration) 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 SN: US37390585 Name | Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 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) 18-Oct-01 (in house check Oct-17) | Apr-18 Apr-18 Apr-18 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 In house check: Oct-18 In house check: Oct-18 |

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





Schweizerischer Kalibrierdienst S

Service suisse d'étalonnage С

Servizio svizzero di taratura

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

Glossarv:

| 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%.

Certificate No: D750V3-1180_Feb18

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S **Swiss Calibration Service**

Accreditation No.: SCS 0108

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 ³ (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 ³ (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 ³ (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 ³ (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) |

Certificate No: D750V3-1180_Feb18

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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 |

Certificate No: D750V3-1180_Feb18

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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

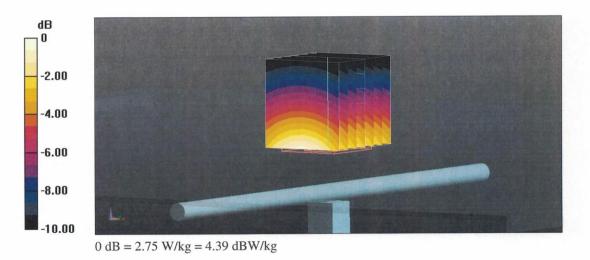
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.89 S/m; ϵ_r = 41.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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)

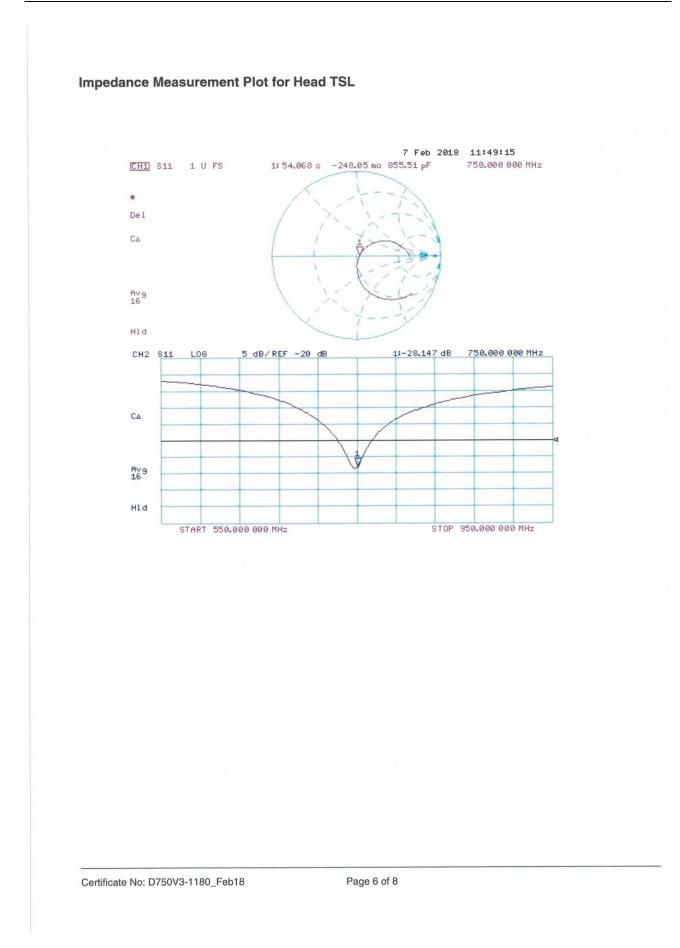
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



Certificate No: D750V3-1180_Feb18

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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

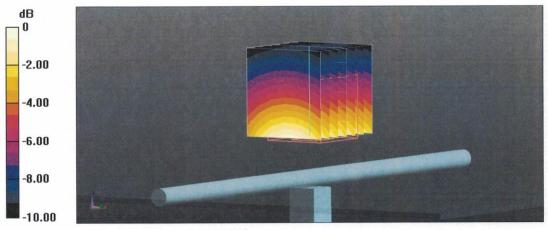
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.96 S/m; ϵ_r = 55.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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

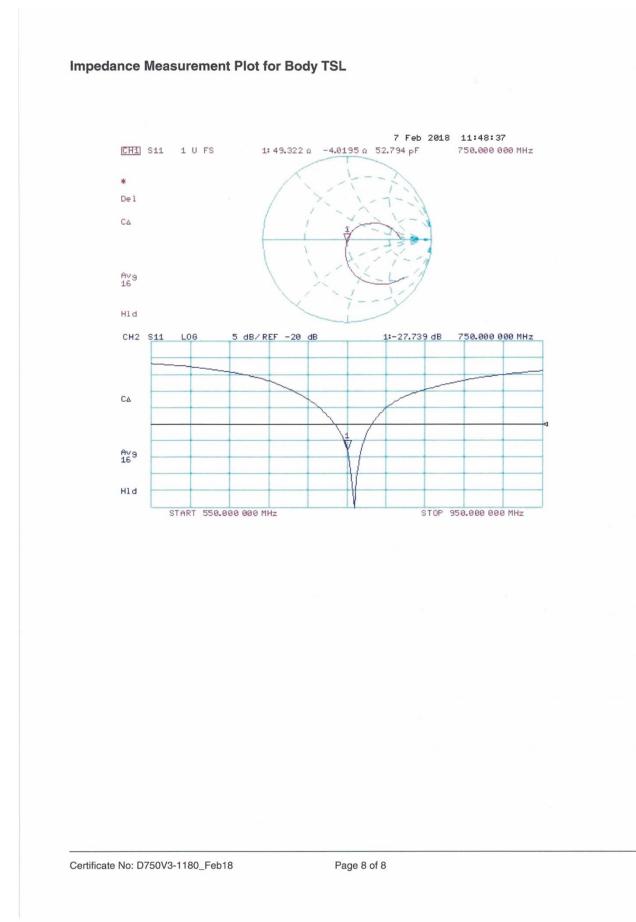
Reference Value = 57.48 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.15 W/kg SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.42 W/kg Maximum value of SAR (measured) = 2.80 W/kg



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

Certificate No: D750V3-1180_Feb18

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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 | Poturn loop (dP) | Dolto (9/) | 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.

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

1.2. D835V2 Dipole Calibration Certificate

| Calibration Laborat Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Z | | | Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service |
|--|--|--|--|
| Accredited by the Swiss Accre The Swiss Accreditation Se Multilateral Agreement for t Client CCIC-HTW | rvice is one of the signator he recognition of calibratio | es to the EA n certificates | reditation No.: SCS 0108 D835V2-4d238_Feb18 |
| CALIBRATION | CERTIFICAT | E | |
| Object | D835V2 - SN:4 | | |
| Calibration procedure(s) | QA CAL-05.v9 Calibration pro | cedure for dipole validation kits abo | ve 700 MHz |
| Calibration date: | February 19, 2 | 018 | |
| This calibration certificate of The measurements and the | documents the traceability to e uncertainties with confidence | national standards, which realize the physical ur e probability are given on the following pages ar | its of measurements (SI). Id are part of the certificate. |
| All calibrations have been | conducted in the closed labor | atory facility: environment temperature $(22 \pm 3)^{\circ}$ | C and humidity < 70%. |
| Calibration Equipment use | ed (M&TE critical for calibratio | n) | |
| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration Apr-18 |
| Power meter NRP | SN: 104778 | 04-Apr-17 (No. 217-02521/02522) | Apr-18 Apr-18 |
| | an1 (00011 | 04-Apr-17 (NO. 21/-02321) | |

| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 | SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 | 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) | Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 |
|--|---|--|---|
| Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E | ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585 | 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 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 |
| Calibrated by: | Name Michael Weber | Function Laboratory Technician | Signature |
| Approved by: | Katja Pokovic | Technical Manager | Issued: February 19, 2018 |
| This calibration certificate shall r | not be reproduced except | in full without written approval of the laboratory. | |

Certificate No: D835V2-4d238_Feb18

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





Schweizerischer Kalibrierdienst S

Service suisse d'étalonnage С

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 | 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%.

Certificate No: D835V2-4d238_Feb18

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Measurement Conditions D

| ASY system configuration, as far as not | prove | V52.10.0 |
|---|------------------------|-------------|
| DASY Version | DASY5 | |
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| | 835 MHz ± 1 MHz | |
| Frequency | | |

Head TSL parameters

| e following parameters and calculations were appli | Temperature | Permittivity | Conductivity |
|--|-----------------|--------------|------------------|
| | 22.0 °C | 41.5 | 0.90 mho/m |
| Nominal Head TSL parameters | (00.00.0) °C | 41.2 ± 6 % | 0.92 mho/m ± 6 % |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 41.2 ± 0 % | |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|--|---|---------------------------------------|
| | 250 mW input power | 2.42 W/kg |
| SAR measured | | 9.51 W/kg ± 17.0 % (k=2) |
| SAR for nominal Head TSL parameters | normalized to 1W | 3.51 Wikg 2 Hit H () |
| | | |
| | | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | | 1.56 W/kg |
| SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured SAR for nominal Head TSL parameters | condition 250 mW input power normalized to 1W | 1.56 W/kg 6.15 W/kg ± 16.5 % (k=2) |

Body TSL parameters and calculations were applied.

| ne following parameters and calculations were appri | Temperature | Permittivity | Conductivity | |
|---|-----------------|--------------|------------------|--|
| | 22.0 °C | 55.2 | 0.97 mho/m | |
| Nominal Body TSL parameters | (22.0 ± 0.2) °C | 55.0 ± 6 % | 0.99 mho/m ± 6 % | |
| Measured Body TSL parameters Body TSL temperature change during test | < 0.5 °C | | | |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| | 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 | Hormanizo a re | |
| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
| | 250 mW input power | 1.60 W/kg |
| | | 6.32 W/kg ± 16.5 % (k=2) |
| SAR measured SAR for nominal Body TSL parameters | normalized to 1W | 0.32 W/kg 1 10.0 /0 () |

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| to feed point | 50.8 Ω - 4.0 jΩ |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | - 27.8 dB |
| Return Loss | |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 47.6 Ω - 6.0 jΩ |
|--------------------------------------|-----------------|
| Impedance, transionned to recu point | - 23.6 dB |
| Return Loss | - 20.0 dD |

General Antenna Parameters and Design

| | 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

| Menufactured by | SPEAG |
|-----------------|---------------|
| Manufactured by | June 02, 2017 |
| Manufactured on | |

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

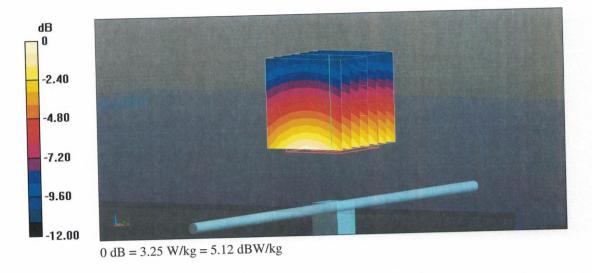
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ϵ_r = 41.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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)

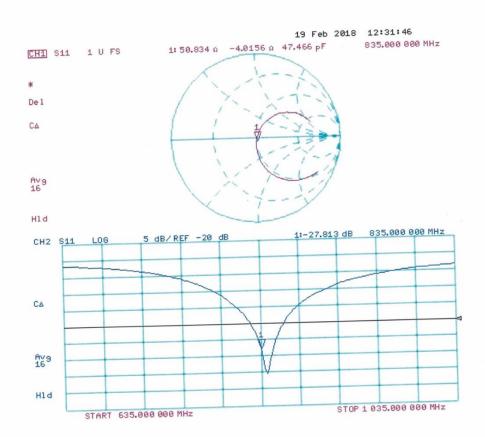
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



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

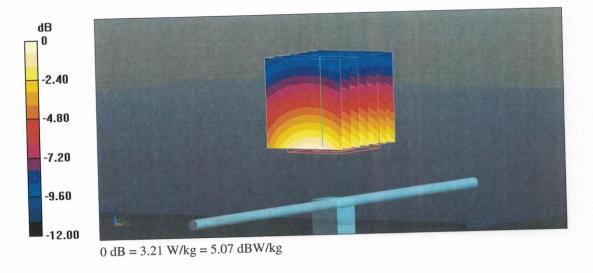
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.99 S/m; ϵ_r = 55; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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)

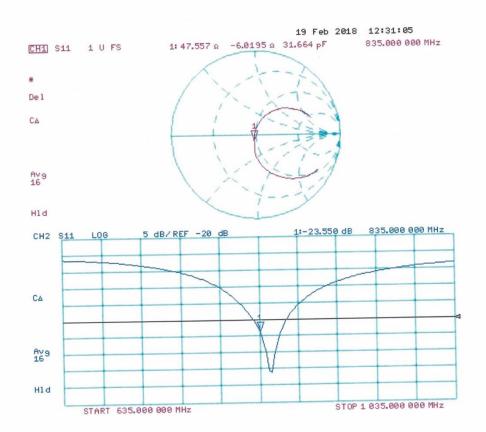
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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



Certificate No: D835V2-4d238_Feb18

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Impedance Measurement Plot for Body TSL

Certificate No: D835V2-4d238_Feb18

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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 | Poturn loop (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

| | | and all the second s | |
|---|--|--|---|
| ccredited by the Swiss Accreditation The Swiss Accreditation Service in Iultilateral Agreement for the rec | is one of the signatories | s to the EA | ccreditation No.: SCS 0108 |
| Client CCIC-HTW (Aud | en) | Certificate N | lo: D1750V2-1164_Feb18 |
| CALIBRATION C | ERTIFICATE | | |
| Object | D1750V2 - SN:11 | 64 | |
| Calibration procedure(s) | QA CAL-05.v9 Calibration proces | dure for dipole validation kits ab | oove 700 MHz |
| Calibration date: | February 06, 201 | 8 | |
| Calibration Equipment used (M&T Primary Standards Power meter NRP Power sensor NRP-Z91 | E critical for calibration) | Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) | Scheduled Calibration Apr-18 Apr-18 |
| Power sensor NRP-291 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination | SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 | 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) | Apr-18 Apr-18 Apr-18 |
| Reference Probe EX3DV4 DAE4 | SN: 7349 SN: 601 | 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) | Dec-18 Oct-18 |
| Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E | ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585 | 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 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 |
| Calibrated by: | Name Leif Klysner | Function Laboratory Technician | Signature |
| Approved by: | Katja Pokovic | Technical Manager | Lelly |
| | | | Issued: February 6, 2018 |

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





S Schweizerischer Kalibrierdienst

C Service suisse d'étalonnage

Accreditation No.: SCS 0108

Servizio svizzero di taratura

S 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

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%.

Certificate No: D1750V2-1164_Feb18

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Measurement Conditions

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

| DASY5 | V52.10.0 |
|------------------------|--|
| Advanced Extrapolation | |
| Modular Flat Phantom | |
| 10 mm | with Spacer |
| dx, dy, dz = 5 mm | |
| 1750 MHz ± 1 MHz | |
| | Advanced Extrapolation Modular Flat Phantom 10 mm dx, dy, dz = 5 mm |

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 ³ (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 ³ (10 g) of Head TSL | condition | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured | condition 250 mW input power | 4.83 W/kg |

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 ³ (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 ³ (10 g) of Body TSL | condition | |
| SAR measured | 250 mW input power | 1.81 W/kg |

| 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) |

Certificate No: D1750V2-1164_Feb18

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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 | |

Certificate No: D1750V2-1164_Feb18

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DASY5 Validation Report for Head TSL

Date: 06.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

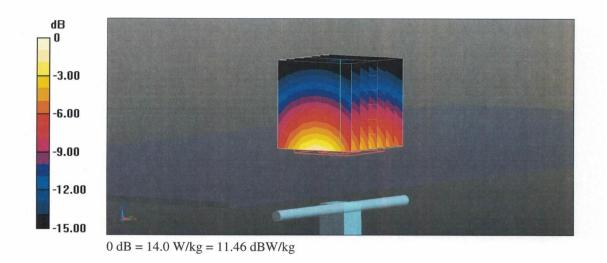
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1164

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.35 S/m; ε _r = 39.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

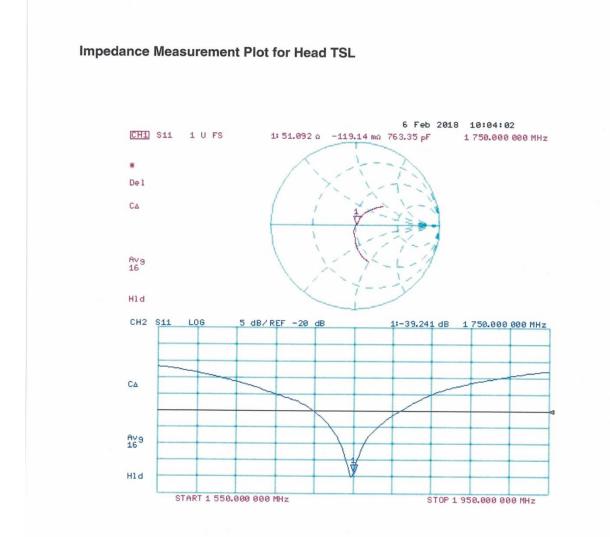
- Probe: EX3DV4 SN7349; ConvF(8.5, 8.5, 8.5); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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



Certificate No: D1750V2-1164_Feb18

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Certificate No: D1750V2-1164_Feb18

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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

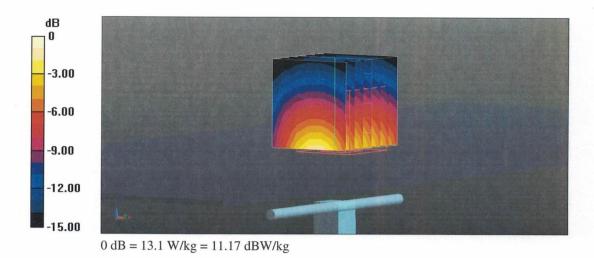
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.46 S/m; ϵ_r = 53.5; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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)

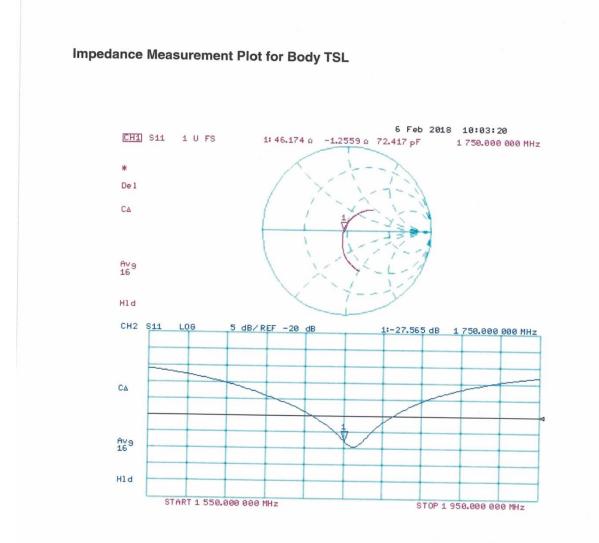
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



Certificate No: D1750V2-1164_Feb18

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Certificate No: D1750V2-1164_Feb18

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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 | Daturn Iooo (dD) Dalta | | 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 Laborato Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurio | | CCREDITATION | S Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura S Swiss Calibration Service |
|--|----------------------------------|---|--|
| Accredited by the Swiss Accredit The Swiss Accreditation Servic Multilateral Agreement for the r | e is one of the signator | ies to the EA n certificates | Accreditation No.: SCS 0108 |
| Client CCIC-HTW (Au | ıden) | Certificate | No: D1900V2-5d226_Feb18 |
| CALIBRATION O | CERTIFICAT | E | |
| Object | D1900V2 - SN:5 | 5d226 | |
| Calibration procedure(s) | QA CAL-05.v9 Calibration proc | edure for dipole validation kits a | bove 700 MHz |
| Calibration date: | February 22, 20 | 18 | |
| All calibrations have been conduc Calibration Equipment used (M& Primary Standards | | ory facility: environment temperature (22 ± 3 Cal Date (Certificate No.) | |
| Power meter NRP | SN: 104778 | 04-Apr-17 (No. 217-02521/02522) | Scheduled Calibration |
| 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 Apr-18 |
| Type-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) | 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) | In house check: Oct-18 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| RF generator R&S SMT-06 Network Analyzer HP 8753E | SN: 100972 | 15-Jun-15 (in house check Oct-16) | In house check: Oct-18 |
| Herein Analyzer FF 0/33E | SN: US37390585 | 18-Oct-01 (in house check Oct-17) | In house check: Oct-18 |
| Callbarted by | Name | Function | Signature |
| Calibrated by: | Michael Weber | Laboratory Technician | Milles |
| Approved by: | Katja Pokovic | Technical Manager | fol lly |
| - | | | Issued: February 22, 2018 |
| This calibration certificate shall no | t be reproduced except in | full without written approval of the laborato | ry. |

Certificate No: D1900V2-5d226_Feb18

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