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Appendix C

Phantom Description

Schmid & Partner Engineering AG а

Zeughausstlasse 43, 8004 Zurich, Switzerland Prione +41 44 245 9700, Fax +41 44 245 9779 info@spissa.com, Mitpi/Www.spiesa.co

Certificate of Conformity / First Article Inspection

| Item | Oval Flat Phantom ELI 5.0 | |
|--------------|--|--|
| Type No | QD OVA 002 A | |
| Series No | 1108 and higher | |
| Manufacturer | Untersee Composites Knebelstrasse 8, CH-8258 Mannenbach, Switzerland | |

Tests

Complete tests were made on the prototype units QD OVA 001 A, pre-series units QD OVA 001 B as well as on some series units QD OVA 001 B. Some tests are made on all series units QD OVA 002 A.

| Test | Requirement | Details | Units tested |
|-------------------------|---|---|---------------------------------|
| Shape | Internal dimensions, depth and sagging are compatible with standards | Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for t > 375 MHz | Prototypes |
| Material thickness | Bottom: 2 0mm +/- 0 2mm | dimension compliant with [3] for f > 800 MHz | all. |
| Material parameters | rel. permittivity 2 - 5, loss tangent ≤ 0.05, at f ≤ 6 GHz | rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05 | Material samples |
| Material resistivity | Compatibility with tissue simulating liquids | Compatible with SPEAG liquids. ** | Phantoms, Material sample |
| Sagging | Sagging of the flat section in tolerance when filled with tissue simulating liquid. | within tolerance for filling height up to 155 mm | Prototypes, samples |

Note: Compatibility restrictions apply certain liquid components mentioned in the standard, containing e.g. DGBE, DGMHE or Triton X-100. Observe technical note on material compatibility.

- OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 81-01
 IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific. Absorption Rate (SAR) in the Human Head from Wireless Communications Devices. Measurement
- Techniques, December 2003 IEC 62209–1 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1
- Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz). 2005-02-18

 [4] IEC 62209-2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices Human models, instrumentation, and procedures Part 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)", 2010-03-30.

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of body-worn SAR measurements and system performance checks as specified in [1 – 4] and further standards

Signature / Stamp

Doc No. 881 - QD OVA 002 A - A

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System Validation from Original Equipment Supplier

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





Service suisse d'étalonnage C Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

SGS-TW (Auden)

Certificate No: D750V3-1015 Aug20

| Object | D750V3 - SN:1015 | | |
|---|--|--|---|
| | QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz | | |
| Calibration date: | August 13, 2020 | | |
| The measurements and the uncertainty | ainties with confidence p | onal standards, which realize the physical un- robability are given on the following pages are by facility: environment temperature $(22 \pm 3)^{\circ}$ | d are part of the certificate. |
| Calibration Equipment used (M&TE | critical for calibration) | | |
| Primary Standards | ID N | Cal Date (Certificate No.) | Scheduled Calibration |
| Power meter NRP | SN: 104778 | 01-Apr-20 (No. 217-03100/00101) | Apr-21 |
| Power sensor NRP-Z91 | SN: 103244 | 01-Apr-20 (No. 217-03100) | Apr-21 |
| Power sensor NRP-Z91 | SN: 103245 | 01-Apr-20 (No. 217-03101) | Apr-21 |
| Reference 20 dB Attenuator | SN. BH9394 (20k) | 31-Mar-20 (No. 217-03106) | Apr-21 |
| Type-N mismatch combination | SN: 310982 / 06327 | 31-Mar-20 (No. 217-03104) | Apr-21 Jon-21 |
| Reference Probe EX3DV4 DAE4 | SN: 7349 SN: 601 | 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) | Dec-20 |
| DOI: 1 | Compa | Check Date (in house) | Scheduled Check |
| | ID# | 11 | In house check: Oct-20 |
| Secondary Standards | ID# SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | III DUUSB GIBON, OCI-20 |
| Secondary Standards Power meter E4419B | | 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) | |
| Secondary Standards Power meter E4419B Power sensor HP 8481A | SN: GB39512475 | | in house check: Oct-20 |
| Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A | SN: GB99512475 SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 In house check: Oct-20 |
| Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 | SN: GB39512475 SN: US37292783 SN: MY41092317 | 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agillant C0350A | SN: GB99512475 SN: US37292783 SN: MY41092317 SN: 100972 CN: UE41000477 Name | 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31 Mar 14 (in house check Oct 19) Function | In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 Signature |
| Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agillant C0350A | SN: GB98512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: UE41090477 | 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-16) 31 Mar 14 (in house check Oct-10) | In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house shock: Oct-20 |
| Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8491A RF generator R&S SMT-06 | SN: GB99512475 SN: US37292783 SN: MY41092317 SN: 100972 CN: UE41000477 Name | 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31 Mar 14 (in house check Oct 19) Function | In house check; Oct-20 In house check; Oct-20 In house check; Oct-20 In house shock; Oct-20 |

Certificate No: D750V3-1015_Aug20

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





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

Swiss Calibration Service Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

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: D750V3-1015 Aug20

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Measurement Conditions

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

| DASY Version | DASY5 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 750 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 41.9 | 0.89 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) "C | 42.4 ± 6 % | 0.91 mha/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | - | - |

SAR result with Head TSL

| SAR averaged over 1 cm3 (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 2.15 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 8.48 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 1.40 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 5.53 W/kg ± 16.5 % (k=2) |

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 52.7 Ω - 0.5 μΩ | |
|--------------------------------------|-----------------|--|
| Return Loss | -31,5 dB | |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1,038 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|
|-----------------|-------|

Certificate No. D750V3-1015_Aug20

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DASY5 Validation Report for Head TSL

Date: 13.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1015

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

Medium parameters used: f = 750 MHz; $\sigma = 0.91$ S/m; $\epsilon_r = 42.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.97, 9.97, 9.97) @ 750 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 59.36 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.22 W/kg

SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.4 W/kg

Smallest distance from peaks to all points 3 dB below = 18.4 mm Ratio of SAR at M2 to SAR at M1 = 66.8%

Maximum value of SAR (measured) = 2.85 W/kg



0 dB = 2.85 W/kg = 4.55 dBW/kg

Certificate No: D750V3-1015_Aug20

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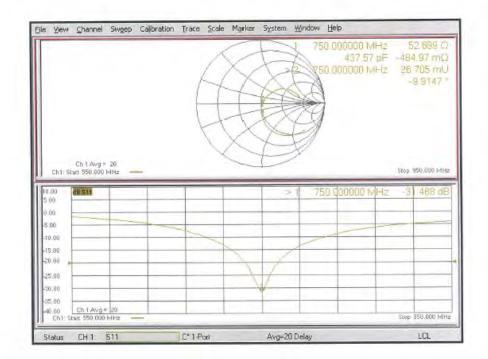
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Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1015_Aug20

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Client SGS-TW (Auden)

Certificate No: D835V2-4d063_Aug20

| Object | D835V2 - SN:4d063 | | |
|------------------------------------|------------------------------------|--|--------------------------------|
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | dure for SAR Validation Sources | between 0.7-3 GHz |
| Calibration date: | August 13, 2020 | | |
| The measurements and the uncertain | ainties with confidence p | onal standards, which realize the physical un robability are given on the following pages an y facility: environment temperature (22 ± 3)° 0 | d are part of the certificate. |
| Calibration Equipment used (M&TE | critical for calibration) | | |
| Primary Standards | ID# | Cal Date (Certificate No.) | Scheduled Calibration |
| Power meter NRP | SN: 104778 | 01-Apr-20 (No. 217-03100/03101) | Apr-21 |
| ower sensor NRP-Z91 | SN: 103244 | 01-Apr-20 (No. 217-03100) | Apr-21 |
| ower sensor NRP-Z91 | SN: 103245 | 01-Apr-20 (No. 217-03101) | Apr-21 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 31-Mar-20 (No. 217-03106) | Apr-21 |
| Type-N mismatch combination | SN: 310982 / 06327 | 31-Mar-20 (No. 217-03104) | Apr-21 Jun-21 |
| Reference Probe EX3DV4 DAE4 | SN: 7349 SN: 601 | 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) | Dec-20 |
| Secondary Standards | ID# | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Aglient E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-19) | In house check: Oct-20 |
| | Name | Function | Signature |
| Calibrated by: | deffrey Kalzman | Laboratory Technician | J. Lugtus |
| Approved by: | Katja Pokovic | Technical Manager | cells |
| Approved by: | Katja Pokovic | Technical Manager | dell |

Certificate No: D835V2-4d063_Aug20

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Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrassa 43, 8004 Zurich, Switzerland





Schweizerlscher Kalibrierdienst Service suisse d'étalonnage C Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

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
- 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: D835V2-4d063_Aug20

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Measurement Conditions

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

| DASY Version | DASY5 | V52 10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 835 MHz ± 1 MHz | |

Head TSL parameters

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 "C | 41.5 | 0.90 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 42.2 ± 6 % | 0.93 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | - Alleria | ann. |

SAR result with Head TSL

| SAR averaged over 1 cm3 (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 2.43 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 9.52 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm3 (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 1,58 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 6.21 W/kg ± 16.5 % (k=2) |

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 50.0 Ω - 2.0 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 34,0 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.392 ns |
|----------------------------------|----------|
| Electrical pelay (one discount) | |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|

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DASY5 Validation Report for Head TSL

Date: 13.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d063

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

Medium parameters used: f = 835 MHz; $\sigma = 0.93$ S/m; $\varepsilon_r = 42.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 29.06.2020

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

Electronics: DAE4 Sn601; Calibrated: 27.12.2019

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

DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 62.56 V/m; Power Drift = -0.05 dB

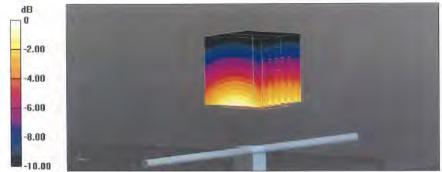
Peak SAR (extrapolated) = 3.61 W/kg

SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.58 W/kg

Smallest distance from peaks to all points 3 dB below = 17 mm

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

Maximum value of SAR (measured) = 3.19 W/kg



0 dB = 3.19 W/kg = 5.04 dBW/kg

Certificate No: D835V2-4d063_Aug20

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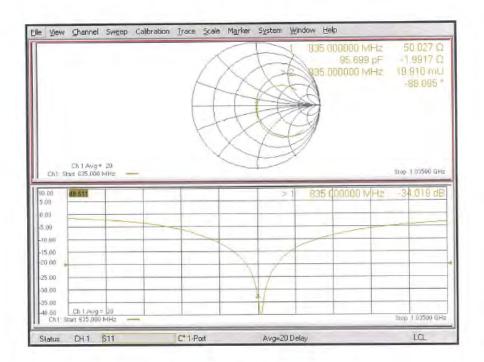
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Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d063_Aug20

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





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Multilateral Agreement for the recognition of calibration certificates

Client St

SGS-TW (Auden)

Certificate No: D1750V2-1008_Aug20

| Object | D1750V2 - SN:10 | 008 | |
|---|--|--|--|
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | dure for SAR Validation Sources | between 0.7-3 GHz |
| Calibration date: | August 14, 2020 | | |
| The measurements and the uncer | tainties with confidence p | conal standards, which realize the physical un- robability are given on the following pages an ry facility: environment temperature $(22 \pm 3)^{\circ}$ 0 | nd are part of the certificate. |
| Calibration Equipment used (M&T | E critical for calibration) | | |
| 44 | 1.5 | | |
| | (D # | Cal Date (Certificate No.) | Scheduled Calibration |
| ower meter NRP | SN: 104778 | 01-Apr-20 (No. 217-03100/03101) | Apr-21 |
| Power meter NRP Power sensor NRP-Z91 | SN: 104778 SN: 103244 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) | Apr-21 Apr-21 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 | SN: 104778 SN: 103244 SN: 103245 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) | Apr-21 Apr-21 Apr-21 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) | Apr-21 Apr-21 Apr-21 Apr-21 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) | Apr-21 Apr-21 Apr-21 Apr-21 |
| 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 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dac-19 (No. DAE4-601_Dec19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dac-19 (No. DAE4-601_Dec19) Check Date (in house) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dac-19 (No. DAE4-601_Dec19) Check Date (in house) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 31992 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power meter E4419B Power sensor HP 8481A Propersensor HP 8481A RF generator R&S SMT-06 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349 Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 319982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dac-19 (No. DAE4-601_Dac19) Check Date (in house) 30-Oct-1-4 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-1-4 (in house check Oct-19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Natwork Analyzer Agilent FR358A | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 31992 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19) Function | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 |

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





S Schweizerischer Kalibrierdienst
Service suisse d'étalonnage
Servizio svizzero di tarature
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
- EC 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 Version | DASY5 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 1750 MHz ± 1 MHz | |

Head TSL parameters

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 40.1 | 1.37 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 40.4 ± 6.% | 1.35 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | - |

SAR result with Head TSL

| SAR averaged over 1 cm3 (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 8.89 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 36.0 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 4.68 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 18.9 W/kg ± 16.5 % (k=2) |

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | $51.2 \Omega + 1.4 j\Omega$ | |
|--------------------------------------|-----------------------------|--|
| Return Loss | -34.9 dB | |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.221 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight wanning of the tipole near the feedpoint can be measured.

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

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

Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|
| | |

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DASY5 Validation Report for Head TSL

Date: 14.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1008

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

Medium parameters used: f = 1750 MHz; $\sigma = 1.35 \text{ S/m}$; $\varepsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.58, 8.58, 8.58) @ 1750 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1,4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type; QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

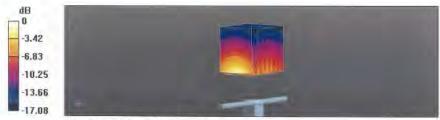
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 103.4 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 8.89 W/kg; SAR(10 g) = 4.68 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 55% Maximum value of SAR (measured) = 13.3 W/kg



0 dB = 13.3 W/kg = 11.24 dBW/kg

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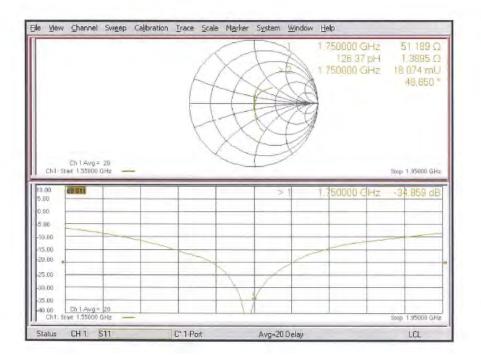
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Impedance Measurement Plot for Head TSL



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Accreditation No.: SCS 0108

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Contillanta Nov D1900V2-5d173 Apr20

| Object | D1900V2 - SN:50 | 1173 | |
|---|---|---|---|
| | | | |
| calibration procedure(s) | QA CAL-05.v11 Calibration Proce | dure for SAR Validation Sources | between 0.7-3 GHz |
| | | | |
| Calibration date: | April 22, 2020 | | |
| | | | |
| | | onal standards, which realize the physical un | |
| he measurements and the uncert | ainties with confidence p | robability are given on the following pages an | nd are part of the certificate. |
| NI Uh Corre base seed tot | ad to the placed laborator | y facility: environment temperature (22 ± 3)°0 | C and humidity < 70% |
| ill calibrations have been conducte | ed in the closed laborator | y lacinty, environment temperature (22 ± 3) t | G and normally 4 7076. |
| Calibration Equipment used (M&TE | critical for calibration) | | |
| | | | |
| Suisitation Equipment used (the it | 2 orallogy for canonalisty | | |
| | ID# | Cal Date (Certificate No.) | Scheduled Calibration |
| rimary Standards | 12 | Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) | Scheduled Calibration Apr-21 |
| Primary Standards Power meter NRP | ID# | | |
| Primary Standards Power meter NRP Power sensor NRP-Z91 | ID # SN: 104778 | 01-Apr-20 (No. 217-03100/03101) | Apr-21 Apr-21 Apr-21 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator | ID # SN: 104778 SN: 103244 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) | Apr-21 Apr-21 Apr-21 Apr-21 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 | ID # SN: 104778 SN: 103244 SN: 103245 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) | Apr-21 Apr-21 Apr-21 |
| 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: BH9394 (20k) | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) | Apr-21 Apr-21 Apr-21 Apr-21 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 |
| 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 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03106) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
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| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Anályzer Agilent E8358A | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 |
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Certificate No: D1900V2-5d173 Apr20

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





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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

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
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- 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
- 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: D1900V2-5d173_Apr20

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Measurement Conditions

DASV system configuration, as far as not given on page 1

| DASY Version | DASY5 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 1900 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 40.0 | 1.40 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 41.1 ± 6 % | 1.39 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | (4,000) |

SAR result with Head TSL

| SAR averaged over 1 cm3 (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 9.75 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 39.4 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 5.10 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 20.5 W/kg ± 16.5 % (k=2) |

Certificate No: D1900V2-5d173_Apr20

Page 3 of 6

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | $50.6 \Omega + 5.1 j\Omega$ |
|--------------------------------------|-----------------------------|
| Return Loss | -25.9 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.199 ns |
|----------------------------------|------------|
| missing bond for a manually | 1-17,7 112 |

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 by | SPEAG |

Certificate No: D1900V2-5d173_Apr20

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DASY5 Validation Report for Head TSL

Date: 22.04.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d173

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; $\sigma = 1.39$ S/m; $\epsilon_r = 41.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.6, 8.6, 8.6) @ 1900 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 108.3 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 18.1 W/kg SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.10 W/kgSmallest distance from peaks to all points 3 dB below = 9.8 mm Ratio of SAR at M2 to SAR at M1 = 54.5%Maximum value of SAR (measured) = 15.2 W/kg



0 dB = 15.2 W/kg = 11.82 dBW/kg

Certificate No: D1900V2-5d173 Apr20

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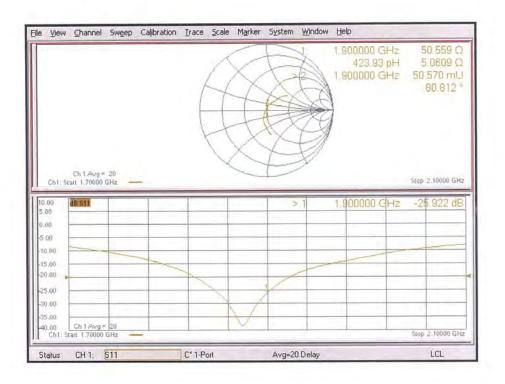
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Impedance Measurement Plot for Head TSL



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





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Accreditation No.: SCS 0108

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D0000V0 1000 Aug00

| ALIBRATION CE | RTIFICATE | | |
|---|---|---|---|
| Object | D2300V2 - SN:10 | 223 | |
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | dure for SAR Validation Sources | between 0,7-3 GHz |
| Calibration date: | August 13, 2020 | | |
| The measurements and the uncertainty | ainties with confidence p | onal standards, which realize the physical uni- robability are given on the following pages an ry facility: environment temperature (22 ± 3)*0 | d are part of the certificate. |
| Calibration Equipment used (M&TE | | | |
| Primary Standards | ID# | Cal Date (Certificate No.) | Scheduled Calibration |
| Power meter NRP | SN: 104778 | 01-Apr-20 (No. 217-03100/03101) | Apr-21 |
| Power sensor NRP-Z91 | SN: 103244 | 01-Apr-20 (No. 217-03100) | Apr-21 |
| Power sensor NRP-Z91 | SN: 103245 | 01-Apr-20 (No. 217-03101) | Apr-21 |
| College against College Trans. | SN: BH9394 (20k) | 31-Mar-20 (No. 217-03106) | Apr-21 |
| Reference 20 dB Attenuator | | | |
| Reference 20 dB Attenuator Type-N mismatch combination | SN: 310982 / 06327 | 31-Mar-20 (No. 217-03104) | Apr-21 |
| Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 310982 / 06327 SN: 7349 SN: 601 | 31-Mar-20 (No. 217-03104) 28-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) | Jun-21 Dec-20 |
| Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 | SN: 7349 | 29-Jun-20 (No. EX3-7349_Jun20) | Jun-21 |
| Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards | SN: 7349 SN: 601 | 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) | Jun-21 Dec-20 |
| Reference 20 dB Attenuator Type-N mismetch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B | SN: 7349 SN: 601 | 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) | Jun-21 Dec-20 Scheduled Check |
| Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 7349 SN: 601 ID # SN: GB39512475 | 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) | Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec18) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) | Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A | SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 | 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) | Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
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Certificate No: D2300V2-1023_Aug20

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- 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
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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Certificate No: D2300V2-1023_Aug20

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Measurement Conditions

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

| DASY Version | DASY5 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2300 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 39.5 | 1.67 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 39.4 ± 6 % | 1.68 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | _ | -64 |

SAR result with Head TSL

| SAR averaged over 1 cm ² (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW Input power | 12.3 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 49.0 W/kg ± 17,0 % (k=2) |

| SAR averaged over 10 cm3 (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 5.93 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 23.7 W/kg ± 16.5 % (k=2) |

Certificate No: D2300V2-1023_Aug20

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 49.0 Ω - 2.4 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 31.5 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.172 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole riear 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 |
|-----------------|-------|
| Manusacured by | |

Certificate No: D2300V2-1023_Aug20

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DASY5 Validation Report for Head TSL

Date: 13.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1023

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used: f = 2300 MHz; $\sigma = 1.68$ S/m; $\varepsilon_r = 39.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.82, 7.82, 7.82) @ 2300 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 115.2 V/m; Power Drift = -0.06 dB

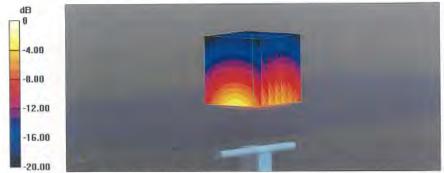
Peak SAR (extrapolated) = 23.1 W/kg

SAR(1 g) = 12.3 W/kg; SAR(10 g) = 5.93 W/kg

Smallest distance from peaks to all points 3 dB below = 9.2 mm

Ratio of SAR at M2 to SAR at M1 = 53,8%

Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg

Certificate No: D2300V2-1023_Aug20

Page 5 of 6

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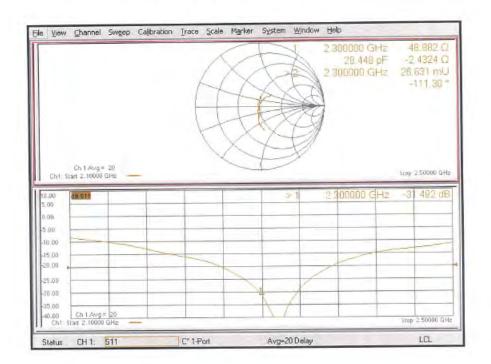
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Impedance Measurement Plot for Head TSL



Certificate No: D2300V2-1023_Aug20

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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client SGS-TW (Auden)

Certificate No: D2450V2-727_Apr20

| bjec) | D2450V2 - SN:72 | 27 | |
|--|--|---|---|
| Calibration procedure(s) | QA CAL-05:v11 Calibration Proce | dure for SAR Validation Sources | s between 0.7-3 GHz |
| Calibration date: | April 22, 2020 | | |
| The measurements and the uncert | tainties with confidence p | onal standards, which realize the physical ur robability are given on the following pages ar by facility: environment temperature (22 ± 3)° | nd are part of the certificate. |
| | Carifool for polibration) | | |
| Calibration Equipment used (M&TI | E critical for calibration) | | |
| | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
| Primary Standards | (military) | Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) | Scheduled Calibration Apr-21 |
| Primary Standards | ID# | | |
| Primary Standards Power meter NRP Power sensor NRP-Z91 | ID # SN: 104778 | 01-Apr-20 (No. 217-03100/03101) | Apr-21 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) | Apr-21 Apr-21 Apr-21 Apr-21 |
| 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: BH9394 (20k) SN: 310982 / 06327 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 |
| 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 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 | ID # SN: 104778 SN: 103244 SN: 103245 SN: B19394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |
| 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: B19394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 | ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) | Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 |

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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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Glossary:

tissue simulating liquid TSL 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
- i) 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
- 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
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

Certificate No: D2450V2-727 Apr20

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Measurement Conditions

| DASY Version | DASY5 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2450 MHz ± 1 MHz | |

Head TSL parameters

and calculations were applied

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 39.2 | 1.80 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 38.6 ± 6 % | 1.86 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL

| SAR averaged over 1 cm3 (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 13.4 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 52.6 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6,23 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 24.7 W/kg ± 16.5 % (k=2) |

Certificate No: D2450V2-727_Apr20

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | $56.0 \Omega + 2.6 j\Omega$ | |
|--------------------------------------|-----------------------------|--|
| Return Loss | - 24.1 dB | |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.149 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|

Certificate No: D2450V2-727 Apr20

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DASY5 Validation Report for Head TSL

Date: 22.04.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:727

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

Medium parameters used: f = 2450 MHz; $\sigma = 1.86$ S/m; $\varepsilon_r = 38.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.98, 7.98, 7.98) @ 2450 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 116.9 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 26.1 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.23 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 51.2%

Maximum value of SAR (measured) = 21.9 W/kg



0 dB = 21.9 W/kg = 13.40 dBW/kg

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Certificate No: D2450V2-727_Apr20

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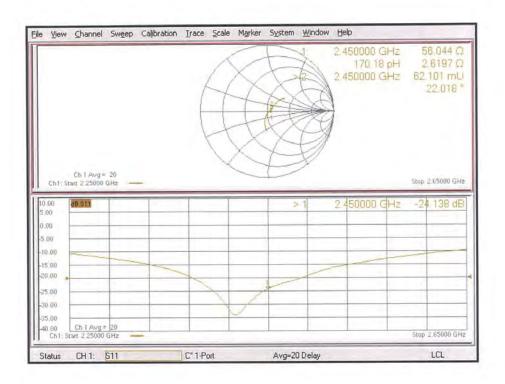
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Impedance Measurement Plot for Head TSL



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





Service suisse d'étalonnage C Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

SGS-TW (Auden)

Certificate No: D2600V2-1005_Jan20

| Object | D2600V2 - SN:1005 | | |
|---|---|--|---|
| Calibration procedure(s) | QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz | | |
| Calibration date: | January 29, 2020 |) | |
| The measurements and the uncertain | aintles with confidence p | ional standards, which realize the physical un probability are given on the following pages an ry facility: environment temperature (22 ± 3)*(| d are part of the certificate. |
| Primary Standards | ID# | Cal Date (Certificate No.) | Scheduled Calibration |
| Power meter NRP | SN: 104778 | 03-Apr-19 (No. 217-02892/02893) | Apr-20 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 | 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) | Apr-20 Apr-20 Apr-20 Apr-20 Dec-20 Dec-20 |
| Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards | SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 | 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 31-Dec-19 (No. EX3-7349_Dec19) | Apr-20 Apr-20 Apr-20 Dec-20 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 03-Åpr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 31-Dec-19 (No. DAE4-601_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19) | Apr-20 Apr-20 Apr-20 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 | SN: 103245 SN: 5058 (20k) SN: 5047 2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37282783 SN: MY41092317 SN: 100972 | 03-Ápr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) | Apr-20 Apr-20 Apr-20 Dec-20 Dec-20 |

Certificate No: D2600V2-1005 Jan20

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





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Glossary:

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

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
- 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: D2600V2-1005_Jan20

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Measurement Conditions

| DASY Version | DASY5 | V52.10.3 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy , $dz = 5 mm$ | |
| Frequency | 2600 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 39.0 | 1.96 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 38.7 ± 6 % | 2.03 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | 1444 | - |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 14.6 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 57.3 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.45 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 25.5 W/kg ± 16.5 % (k=2) |

Certificate No: D2600V2-1005_Jan20

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 48.3 Ω - 4.6 [Ω |
|--------------------------------------|-----------------|
| Return Loss | - 26.1 dB |

General Antenna Parameters and Design

| According to the second | |
|--|----------|
| Electrical Delay (one direction) | 1.156 ns |
| | |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|

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DASY5 Validation Report for Head TSL

Date: 29.01.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1005

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

Medium parameters used: f = 2600 MHz; $\sigma = 2.03 \text{ S/m}$; $\varepsilon_r = 38.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.69, 7.69, 7.69) @ 2600 MHz; Calibrated: 31.12.2019
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 120.5 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 29.7 W/kg SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.45 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 49.2%

Maximum value of SAR (measured) = 24.5 W/kg



0 dB = 24.5 W/kg = 13.89 dBW/kg

Certificate No: D2600V2-1005_Jan20

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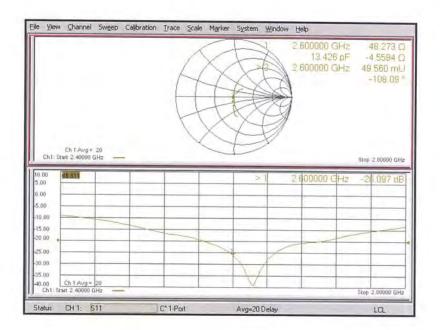
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Impedance Measurement Plot for Head TSL



Certificate No: D2600V2-1005_Jan20

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





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Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

SGS-TW (Auden)

Certificate No: D5GHzV2-1023_Jan20

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN:1023

Calibration procedure(s) QA CAL-22.v4

Calibration Procedure for SAR Validation Sources between 3-6 GHz

Calibration date: January 28, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI) The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID# | Cal Date (Certificate No.) | Scheduled Calibration |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP | SN: 104778 | 03-Apr-19 (No. 217-02892/02893) | Apr-20 |
| Power sensor NRP-Z91 | SN: 103244 | 03-Apr-19 (No. 217-02892) | Apr-20 |
| Power sensor NRP-Z91 | SN: 103245 | 03-Apr-19 (No. 217-02893) | Apr-20 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 04-Apr-19 (No. 217-02894) | Apr-20 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02895) | Apr-20 |
| Reference Probe EX3DV4 | SN: 3503 | 31-Dec-19 (No. EX3-3503_Dec19) | Dec-20 |
| DAE4 | SN: 601 | 27-Dec-19 (No. DAE4-601_Dec19) | Dec-20 |
| Secondary Standards | ID# | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Feb-19) | In house check: Oct-20 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-18) | In house check: Oct-20 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-19) | In house check: Oct-20 |
| | Name | Function | Signature |
| Calibrated by: | Leif Klysner | Laboratory Technician | Sef Iller |
| Approved by: | Katja Pokovic | Technical Manager | Seal |

Certificate No: D5GHzV2-1023 Jan20 Page 1 of 9

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





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Service suisse d'étalonnage
Servizio svizzero di taratura

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:

- 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
- EC 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 Version | DASY5 | V52,10.3 |
|------------------------------|--|----------------------------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom V5.0 | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy = 4.0 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency | 5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz | |

Head TSL parameters at 5200 MHz

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 36.0 | 4.66 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.3 ± 6 % | 4.49 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5200 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 8.05 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 80.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.28 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 22.7 W/kg ± 19.5 % (k=2) |

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Head TSL parameters at 5300 MHz

The following parameters and calculations were applied

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.9 | 4.76 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.2 ± 6 % | 4.59 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5300 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 8.32 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 82.8 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.35 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 23.4 W/kg ± 19.5 % (k=2) |

Head TSL parameters at 5600 MHz

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.5 | 5.07 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 34.8 ± 6 % | 4.89 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | (Leas) | |

SAR result with Head TSL at 5600 MHz

| SAR averaged over 1 cm3 (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 8.36 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 83.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.37 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 23.5 W/kg ± 19.5 % (k=2) |

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Head TSL parameters at 5800 MHz

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.3 | 5.27 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 34.5 ± 6 % | 5.10 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | (Table) | - |

SAR result with Head TSL at 5800 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 8.19 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 81.4 W/kg ± 19.9 % (k=2) |

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

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

| Impedance, transformed to feed point | 50.6 Ω - 8.0 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 22,0 dB |

Antenna Parameters with Head TSL at 5300 MHz

| Impedance, transformed to feed point | 52.4 Ω - 4.7 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 25.8 dB |

Antenna Parameters with Head TSL at 5600 MHz

| Impedance, transformed to feed point | 55.9 Ω - 1.1 <u>j</u> Ω | |
|--------------------------------------|-------------------------|--|
| Return Loss | - 25.0 dB | |

Antenna Parameters with Head TSL at 5800 MHz

| Impedance, transformed to feed point | $56.2 \Omega + 2.9 j\Omega$ | |
|--------------------------------------|-----------------------------|--|
| Return Loss | - 23.8 dB | |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.199 ns |
|----------------------------------|-----------|
| Licential Delay (one direction) | 1,155 115 |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|

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DASY5 Validation Report for Head TSL

Date: 28.01.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1023

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600

MHz, Frequency: 5800 MHz

Medium parameters used: f = 5200 MHz; $\sigma = 4.49$ S/m; $\varepsilon_r = 35.3$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5300 MHz; $\sigma = 4.59 \text{ S/m}$; $\epsilon_r = 35.2$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5600 MHz; $\sigma = 4.89$ S/m; $\epsilon_r = 34.8$; $\rho = 1000$ kg/m³ , Medium parameters used: f = 5800 MHz; $\sigma = 5.1 \text{ S/m}$; $\varepsilon_r = 34.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.8, 5.8, 5.8) @ 5200 MHz, ConvF(5.49, 5.49, 5.49) @ 5300 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

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

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

Reference Value = 77.00 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 28.9 W/kg

SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.28 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 68.9%

Maximum value of SAR (measured) = 18.6 W/kg

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

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

Reference Value = 77.20 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 30.2 W/kg

SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.35 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 68.8%

Maximum value of SAR (measured) = 19.4 W/kg

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

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

Reference Value = 77.04 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 31.6 W/kg

SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.37 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 67.1%

Maximum value of SAR (measured) = 19.9 W/kg

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

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

Reference Value = 75.51 V/m; Power Drift = -0.04 dB

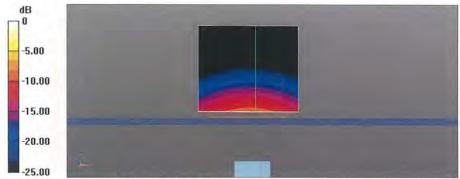
Peak SAR (extrapolated) = 33.1 W/kg

SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.29 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 65.2%

Maximum value of SAR (measured) = 19.8 W/kg



0 dB = 19.9 W/kg = 12.99 dBW/kg

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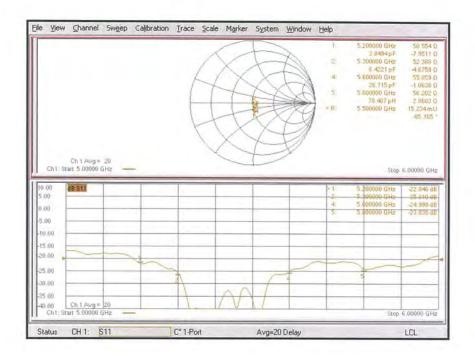
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Impedance Measurement Plot for Head TSL



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