

# Appendix C

# **Phantom Description**

Schmid & Partner Engineering AG

е а s р g

Zeughausstrasse 43, 8004 Zurich, Switzerland Phone +41 44 245 9700, Fax +41 44 245 9779 info@speag.com, http://www.speag.com

#### 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-8268 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 f > 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.

Standards

- [1] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields<sup>®</sup>, Edition 01-01 IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific
- [2] Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
- [3] 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

Conformity

Date

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

реад Schmid & Bartner-Engineering AG Zeugbarestrassa 43, 8004 Zucich, Shittingan Phone 442 44/26/9708, Few 444 64/45 9779

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25.7.2011

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan/新北市五股區新北產業園區五工路 134 號

www.sqs.com.tw



# System Validation from Original Equipment Supplier

Description         D2450V2 - SN:727           Pailbration procedure(s)         QA CAL-05.V11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz           Pailbration date:         April 22, 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 calibration Equipment used (M&TE critical for calibration)           Primary Standards         D #         Cal Date (Certificate No.)         Scheduled Calibration Apr-21 Secondary           Yower sensor NRP-291         SN: 104778         01-Apr-20 (No. 217-03100)         Apr-21 Apr-21 SN: 103244           Yower sensor NRP-291         SN: 104778         01-Apr-20 (No. 217-03100)         Apr-21 Apr-21 SN: 103244           Yower sensor NRP-291         SN: 103245         01-Apr-20 (No. 217-03100)         Apr-21 Apr-21 SN: 103244           Yower sensor NRP-291         SN: 103245         01-Apr-20 (No. 217-03100)         Apr-21 SN: 103245           Yower sensor NRP-291         SN: 103245         01-Apr-20 (No. 217-03100)         Apr-21 SN: 103245           Yower sensor NRP-291         SN: 103245         01-Apr-20 (No. 217-03100)         Apr-21 SN: 103245           Yower sensor NRP-291         SN: 103245         01-Apr-20 (No. 217-03100)         Apr-21 SN:				
Item       SGS-TW (Auden)       Certificate No: D2450V2-727_Apr20         CALIBRATION CERTIFICATE         Deject       D2450V2 - SN:727         Calibration procedure(s)       QA CAL-05_V11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Calibration date:       April 22, 2020         This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (S). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.         All calibration shave been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.         Calibration Equipment used (M&TE critical for calibration)         Prover sensor NRP-291       SN: 104778       O1-Apr-20 (No. 217-03100) Apr-21 SN: 103245       O1-Apr-20 (No. 217-03100) Apr-21 SN: 103245       Apr-21 SN: 103245       O1-Apr-20 (No. 217-03100) Apr-21 SN: 103245       Apr-21 (No. 217-03100) Apr-21 SN: 103245       Apr-21 (No. 217-03100) Apr-21 SN: 103245       SN: 01-Apr-20 (No. 217-	he Swiss Accreditation Service is	s one of the signatories	s to the EA	creditation No.: SCS 0108
Calibration       D2450V2 - SN:727         Calibration procedure(s)       QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Calibration date:       April 22, 2020         This calibration date:       April 22, 2020         This calibration date:       April 22, 2020         This calibration share 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         Prover sensor NRP-231       SN: 104778       01-Apr-20 (No. 217-03100)       Apr-21         Nowr sensor NRP-231       SN: 103245       01-Apr-20 (No. 217-03100)       Apr-21         Reference 20 dB Attenuator       SN: 104778       01-Apr-20 (No. 217-03100)       Apr-21         Nowr sensor NRP-231       SN: 103245       01-Apr-20 (No. 217-03100)       Apr-21         Reference 20 dB Attenuator       SN: 601       27-Dec-19 (No. DAE-601_Dec19)       Dec-20         Secondary Standards       ID #       Check Date (in house)       Scheduled Check         Power sensor NRP-231       SN: 603 27-25       Scheduled Check       Schedule Check         Power sensor NRP-231       SN: 603 27-205       Schedule Check       Sched				D2450V2-727 Apr20
Dbject         D2450V2 - SN:727           Calibration procedure(s)         QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz           Calibration date:         April 22, 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 calibration shave 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         D #         Cal Date (Certificate No.)         Scheduled Calibration           Prower sensor NRP-231         SN: 104778         O1-Apr-20 (No. 217-03100/03101)         Apr-21           Power sensor NRP-231         SN: 103244         O1-Apr-20 (No. 217-03100)         Apr-21           Reference 20 dB Attenuator         SN: 104278         O1-Apr-20 (No. 217-03101)         Apr-21           Reference 20 dB Attenuator         SN: 601         27-Dec-19 (No. 217-03104)         Apr-21           SN: 601         27-Dec-19 (No. 217-03104)         Apr-21           Reference Probe EX3DV4         SN: 61         27-Dec-19 (No. 247-03104)         Apr-21           SN: 610         27-Dec-19 (No. 247-03104)         Apr-21         Sched				. DEHOUTE TET_Apres
Calibration procedure(s)       QA CAL-05,v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Calibration date:       April 22, 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 Nc.)       Scheduled Calibration         Prower sensor NRP-291       SN: 104778       01-Apr-20 (No. 217-03100) 3010)       Apr-21         Power sensor NRP-291       SN: 103245       01-Apr-20 (No. 217-03100)       Apr-21         Reference 20 dB Attenuator       SN: 31082 (208327       31-Mar-20 (No. 217-03101)       Apr-21         Nyae-N mismatch combination       SN: 31082 (208327       31-Mar-20 (No. 217-03104)       Apr-21         Reference 20 dB Attenuator       SN: 601       27-Dec-19 (No. DAE4-601_Dec19)       Dec-20         Secondary Standards       ID #       Check Date (in house check Cot-18)       In house check: Cot-20         Power meter E44198       SN: 03925273       30-Cot-14 (in house check Cot-18)       In house check: Cot-20	CALIBRATION CI	ERTIFICATE		
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Calibration date:       April 22, 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 calibration Equipment used (M&TE critical for calibration)       Cal Date (Certificate No.)       Scheduled Calibration         Power meter NRP       SN: 104778       01-4pr-20 (No. 217-03100/03101)       Apr-21         Power sensor NRP-Z91       SN: 103244       01-4pr-20 (No. 217-03100)       Apr-21         Reference 20 dB Attenuator       SN: 103245       01-4pr-20 (No. 217-03100)       Apr-21         Reference Probe EX3DV4       SN: 310982 / 06327       31-Mar-20 (No. 217-03101)       Apr-21         Reference Probe EX3DV4       SN: 310982 / 06327       31-Mar-20 (No. 217-03104)       Apr-21         Reference Probe EX3DV4       SN: 310982 / 06327       31-Mar-20 (No. 217-03104)       Apr-21         Reference Probe EX3DV4       SN: 601       27-Dec-19 (No. DAE4-601_Dec19)       Dec-20         Secondary Standards       D#       Check Date (in house)       Scheduled Check         Power sensor HP 8481A       SN: US37292783       30-Oct-14 (in house check Feb-19)       In house check: Oct-20	Dbject	D2450V2 - SN:72	27	
Calibration date:       April 22, 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 procedure(s)			the second second
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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: 103245         01-Apr-20 (No. 217-03101)         Apr-21           Type-N mismatch combination         SN: 310982 / 06327         31-Mar-20 (No. 217-03106)         Apr-21           Reference Probe EX3DV4         SN: 7349         31-Dec-19 (No. ZX-7349_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 sensor HP 8481A         SN: US37292783         07-Oct-15 (in house check Feb-19)         In house check: Oct-20           Power sensor HP 8481A         SN: 100972         15-Jun-15 (in house check Oct-18)         In house check: Oct-20           RF generator R&S SMT-06         SN: US41080477         31-Mar-14 (in house check Oct-19)         In house check: Oct-20           Network Analyzer Agilent E8358A         Name         Function         Signature           Calibrated by:         Jeffrey Katzman         Laboratory Technician         Jumout			ry facility: environment temperature $(22 \pm 3)^{\circ}$	C and humidity < 70%.
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       Reference Probe EX3DV4     SN: 310982 / 06327     31-Mar-20 (No. 217-03104)     Apr-21       SN: 310982 / 06327     31-Mar-20 (No. 217-03104)     Apr-21       SN: 310982 / 06327     31-Mar-20 (No. 217-03104)     Apr-21       SN: 310982 / 06327     31-Mar-20 (No. EX3-7349_Dec19)     Dec-20       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 Cot-18)     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: WY41092317     07-Oct-15 (in house check Oct-18)     In house check: Oct-20       SN: 100972     15-Jun-15 (in house check Oct-18)     In house check: Oct-20       SN: US41080477     31-Mar-14 (in house check Oct-19)     In house check: Oct-20       Name     Function     Signature       Calibrated by:     Jeffrey Katzman     Laboratory Technician	Calibration Equipment used (M&TE	critical for calibration)		
Reference 20 dB Attenuator     SN: BH9394 (20k)     31-Mar-20 (No. 217-03106)     Apr-21       Type-N mismatch combination     SN: BH9394 (20k)     31-Mar-20 (No. 217-03106)     Apr-21       SN: 310982 / 06327     31-Mar-20 (No. 217-03106)     Apr-21       SN: 510982 / 06327     31-Mar-20 (No. 217-03106)     Apr-21       SN: 510982 / 06327     31-Mar-20 (No. 217-03104)     Apr-21       SN: 501     27-Dec-19 (No. DAE4-601_Dec19)     Dec-20       Secondary Standards     ID #     Check Date (in house)     Scheduled Check       Power meter E44198     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       SN: 10972     15-Jun-15 (in house check Oct-18)     In house check: Oct-20     SN: 10972       Network Analyzer Agilent E8358A     SN: US41080477     31-Mar-14 (in house check Oct-19)     In house check: Oct-20       Calibrated by:     Jeffrey Katzman     Laboratory Technician     Signature	Calibration Equipment used (M&TE Primary Standards	critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Type-N mismatch combination     SN: 310982 / 06327     31-Mar-20 (No. 217-03104)     Apr-21       Reference Probe EX3DV4     SN: 7349     31-Dec-19 (No. EX3-7349_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: 109972     15-Jun-15 (in house check Oct-18)     In house check: Oct-20       RF generator R&S SMT-06     SN: US41080477     31-Mar-14 (in house check Oct-19)     In house check: Oct-20       Name     Function     Signature       Calibrated by:     Jaffrey Katzman     Laboratory Technician     Mddddddddddddddddddddddddddddddddddd	Calibration Equipment used (M&TE Primary Standards Power meter NRP	critical for calibration)	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101)	Scheduled Calibration Apr-21
Reference Probe EX3DV4     SN: 7349     31-Dec-19 (No. EX3-7349_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: W141092317     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       Calibrated by:     Jeffrey Katzman     Laboratory Technician     Signature	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91	critical for calibration) ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100)	Scheduled Calibration Apr-21 Apr-21
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: US37292783     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       Calibrated by:     Jeffrey Katzman     Laboratory Technician     Signature	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	Cal Date (Certificate No.) 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)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21
Secondary Standards         ID #         Check Date (in house)         Scheduled Check           Power meter E44198         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           Calibrated by:         Jeffrey Katzman         Laboratory Technician         Jeffrey	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	Cal Date (Certificate No.) 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)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
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:     Jeffrey Katzman     Laboratory Technician     Mathematican	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	critical for calibration) ID # SN: 104778 SN: 103245 SN: BH0394 (20k) SN: 310982 / 06327 SN: 7349	Cal Date (Certificate No.) 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)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-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:     Jeffrey Katzman     Laboratory Technician     Mddddddddddddddddddddddddddddddddddd	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	critical for calibration) ID # SN: 104778 SN: 103245 SN: BH0394 (20k) SN: 310982 / 06327 SN: 7349	Cal Date (Certificate No.) 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)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-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       Jeffrey Katzman     Laboratory Technician     JMJ	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID #	Cal Date (Certificate No.) 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)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check
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       Calibrated by:     Name     Function     Signature       Jeffrey Katzman     Laboratory Technician     July	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475	Cal Date (Certificate No.)           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)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check 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:     Jeffrey Katzman     Laboratory Technician	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783	Cal Date (Certificate No.)           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-Dac-19 (No. 217-03104)           31-Dac-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)	Scheduled Calibration 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
Calibrated by: Jeffrey Katzman Laboratory Technician J.K.Ju-	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (206)27 SN: 310982 (206327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317	Cal Date (Certificate No.)           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)           07-Oct-15 (in house check Oct-18)	Scheduled Calibration 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
Calibrated by: Jeffrey Katzman Laboratory Technician	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	Cal Date (Certificate No.)           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. 217-03104)           31-Dec-19 (No. 217-03104)           27-Dec-19 (No. DE4-601_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)           15-Jun-15 (in house check Oct-18)	Scheduled Calibration 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 In house check: Oct-20
0 Kga	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	Cal Date (Certificate No.)           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. 217-03104)           31-Dec-19 (No. 217-03104)           27-Dec-19 (No. DE4-601_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)           15-Jun-15 (in house check Oct-18)	Scheduled Calibration 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 In house check: Oct-20
Approved by: Katja Pokovic Technical Manager	Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 31982 / 06327 SN: 31982 / 06327 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US37292783 SN: MY41092317 SN: US41080477 Name	Cal Date (Certificate No.)           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)           15-Jun-15 (in house check Oct-18)           31-Mar-14 (in house check Oct-19)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
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# Glossary:

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

## Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

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#### **Measurement Conditions**

DASY system configuration	, as far a	s not given	on page 1
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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

The following 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 cm <sup>3</sup> (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 <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	6.23 W/kg

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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 Ω + 2.6 jΩ	
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	

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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;  $\epsilon_r = 38.6$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(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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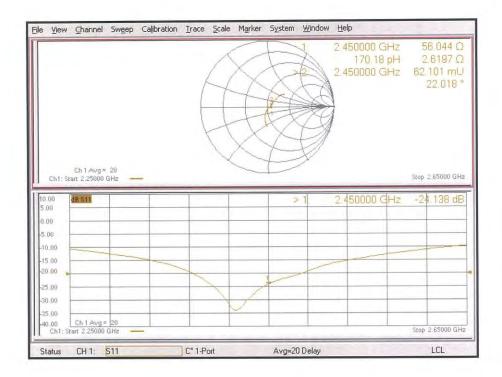
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## Impedance Measurement Plot for Head TSL



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Accredited by the Swiss Accreditation The Swiss Accreditation Service in Aultilateral Agreement for the rec	is one of the signatorie	es to the EA	Accreditation No.: SCS 0108
Client SGS-TW (Auden	1)	Certificate N	No: D5GHzV2-1023_Jan20
CALIBRATION C	ERTIFICATI	E	
Object	D5GHzV2 - SN:	1023	
Calibration procedure(s)	QA CAL-22.v4 Calibration Proce	edure for SAR Validation Source	s between 3-6 GHz
Calibration date:	January 28, 2020	0	
All calibrations have been conducte Calibration Equipment used (M&TE		ry facility: environment temperature (22 $\pm$ 3)	°C and humidity < 70%.
	100 #		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
rimary Standards ower meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
rimary Standards ower meter NRP ower sensor NRP-Z91	SN: 104778 SN: 103244	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892)	Apr-20 Apr-20
rimary Standards ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893)	Apr-20 Apr-20 Apr-20
rrimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91 leference 20 dB Attenuator	SN: 104778 SN: 103244	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 leference 20 dB Attenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893)	Apr-20 Apr-20 Apr-20
rimary Standards ower meter NRP ower sensor NRP-Z91 iower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20
rimary Standards vower meter NRP vower sensor NRP-Z91 vower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 AE4 econdary Standards	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02895) 31-Dec-19 (No. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Dec-20 Dec-20 Scheduled Check
rimary Standards ower meter NRP ower sensor NRP-291 ower sensor NRP-291 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475	03-Apr-19 (No. 217-02892/02893) 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. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
trimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 JAE4 <u>econdary Standards</u> lower meter E4419B lower sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02893) 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)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
rimary Standards ower meter NRP tower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 VAE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	03-Apr-19 (No. 217-02892/02893) 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. EX3-3503_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 Apr-20 Apr-20 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
rimary Standards ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	03-Apr-19 (No. 217-02892/02893) 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. EX3-3503 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-20 Apr-20 Apr-20 Apr-20 Apr-20 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 Reference 20 dB Attenuator ype-N mismatch combination Reference Probe EX3DV4 PAE4 Recondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US41080477	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 31-Dec-19 (No. 217-02895) 31-Dec-19 (No. EX3-3503_Dec19) 27-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 Apr-20 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 Teference 20 dB Attenuator Type-N mismatch combination Type-N mismatch combination Type-N mismatch combination Reference Probe EX3DV4 DAE4 Becondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Letwork Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US3100972 SN: US41080477 Name	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-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) 27-Dec-19 (No. DAE4-601_Dec19) 07-Oct-19 (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) Function	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 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 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 Becondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US41080477	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 31-Dec-19 (No. 217-02895) 31-Dec-19 (No. EX3-3503_Dec19) 27-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 Apr-20 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 Power sensor HP 8481A Power sensor HP 8481A Regenerator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US3100972 SN: US41080477 Name	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-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) 27-Dec-19 (No. DAE4-601_Dec19) 07-Oct-19 (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) Function	Apr-20 Apr-20 Apr-20 Apr-20 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 Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by: Approved by:	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5053 (20k) SN: 5053 SN: 601 ID # SN: G839512475 SN: US37292783 SN: WY41092317 SN: US37292783 SN: WY41092317 SN: 100972 SN: US41080477 Name Leif Klysner	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02893) 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) 15-Jun-15 (in house check Oct-19) Function Laboratory Technician	Apr-20 Apr-20 Apr-20 Apr-20 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20

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



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S Swiss Calibration Service

Accreditation No.: SCS 0108

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## Glossary

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

# Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

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#### Measurement Conditions

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

DASY Version	DASY5	V52.10.3
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

The following parameters and calculations were applied.

	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		17.5°

# SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (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)
SAP averaged over 10 cm <sup>3</sup> (10 c) of Head TSI	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.28 W/kg

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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 <sup>3</sup> (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 <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.35 W/kg

#### 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		

#### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (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 <sup>3</sup> (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 The following parameters and calculations were applied

	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		

### SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (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 <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.29 W/kg

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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 jΩ	
Return Loss	- 25.0 dB	

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.2 Ω + 2.9 jΩ	
Return Loss	- 23.8 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns	
Electrical Delay (one direction)	1.199 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 SPEA	G
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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;  $\sigma = 4.49 \text{ S/m}$ ;  $\epsilon_r = 35.3$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used: f = 5300 MHz;  $\sigma = 4.59 \text{ S/m}$ ;  $\varepsilon_r = 35.2$ ;  $\rho = 1000 \text{ kg/m}^2$ Medium parameters used: f = 5600 MHz;  $\sigma = 4.89 \text{ S/m}$ ;  $\varepsilon_r = 34.8$ ;  $\rho = 1000 \text{ kg/m}^3$ , 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



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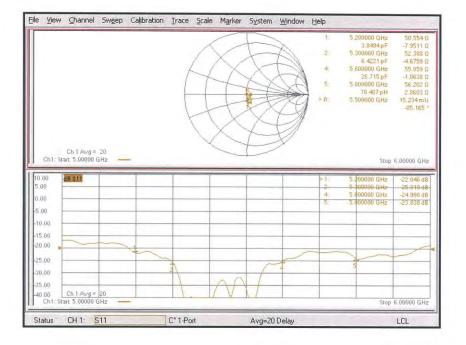
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#### Impedance Measurement Plot for Head TSL



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# - End of report -

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