

Rev: 01

Page: 1 of 73

Appendix C

Phantom Description

Schmid & Partner Engineering AG

S D е а q

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

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

- OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
 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
- 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

25.7.2011 Signature / Stamp

mid & Partner-Engineering AG gboysatresse 43, 8004 Joseph Saland mg/441 44/26-9708 Fevi-40 64-65 9779

Doc No 881 - QD OVA 002 A - A

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Rev: 01

Page: 2 of 73

System Validation from Original Equipment Supplier

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





S Schweizerischer Kalibrierdienal Service suisse d'étalonnage Servicio svizzero di taratura S Swiss Calibration Service

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ing

Certificate No: D750V3-1078_Jun19

CALIBRATION CERTIFICATE D750V3 - SN:1078 QA CAL-05.v11 Calibration procedurers) Calibration Procedure for SAR Validation Sources between 0.7-3 GHz Castroline date June 27, 2019 This calibration cartilicate documents the translability is resional standards, which reside the physical units of measurements (St. The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate All calcultions have been conducted in the closed laboratory facility: environment temperature (22 ± 3)*C and framely = 70% Calibration Equipment used (M&TE chics) for calibration Schmooled Calibration Primary Standards Cal Date (Certificate No.) Power mate: SEIP SN: 104778 US-Apr-19 (No. 217-(289633/893)) Power sensor NRP-291 SN 103244 03-Apr-19 (No. 217-02892) Apr 20 Pawer sensor NRP-Z91 SN: 100245 69-Apr-19 (No. 217-02893) Apr-20 SN 5068 (20k) Reference 20 nB Attenuator (M-Apr-19 (No. 217-02894) Apr-20 Type-N mamatch combination SN 5047.2 / 06327 04-Apr-19 (No. 217-02895) Apr-20 rence Probe EX3DVA SN: 7348 29-May-18 (No. EX3-7349, May19) DAE4 3N 601 30 Apr.19 (No DAE4-801 Apr.19) Apri20 Secondary Standards Check Date (in house) Schemied Check Power meter E44198 SN: GR39512475 30-Oct-14 (in house chuck Teb-19) In house cheek, Oct-26 Fower sensor HP 8481A 5N: U537292783 07-Oct 15 (in house check Oct 18) in house check: Oct-20 Power sensor NP 8481A SN. MY41092917 07-Oct-15 (in house check Oct-18) In house check: Oct-20 RF generator R&S SMT-06 SNI 100972 15-Jun-15 (in Foliaie offick Oct-18) Network Analyzer Action E5358A SN US41080477 31 Mar-14 (in house chaps Oct-18) In trouse check: Oct-16 Function Laboratory Technician Calibrated by: Michiel Wither Kalin Pomovic Technical Manager Approved by This calibration conflicate shall not be reproduced except in full willout written approval of the laboratory

Certificate No. D750V3-1078_Jun19

Page 1 of 8

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Rev: 01

Page: 3 of 73

Calibration Laboratory of

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





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Glossary:

TSL tissue simulating liquid

ConvF sensitivity in TSL / NORM x.y.z N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Flate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- i) 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 priented 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. D750V3-1078_Jun19

Page 2 of 8

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Rev: 01

Page: 4 of 73

Measurement Conditions

far as not given on page 1

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	witt Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

	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	42.0 ± 6 %	0.88 mno/m ± 6 %
Head TSL temperature change during test	≤0,5 ℃		-

SAR result with Head TSL

SAR averaged over 1 cm ⁻¹ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.60 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.60 W/kg ± 16.5 % (k=2)

Body TSL parameters

e following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22 0 °C	55.5	0.96 mma/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5±6%	0.96 mhp/m ± 6 W
Body TSL temperature change during test	< 0.5 °C		_

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.64 W/kg = 17.0 % (k=2)

SAR averaged over 10 cm2 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	nomelized to 1W	5,68 W/kg ± 16.5 % (k=2)

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Page 3 of 8

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Rev: 01

Page: 5 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.4 LL + 1.4 (Q
Rejurn Loss	25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5 (2 - 2.4 #1
Return Loss	- 32 3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.037 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the leedpoint 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-discutted for DC-signals. On some of the dipoles, small and 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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Page 4 of 6

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Rev: 01

Page: 6 of 73

DASY5 Validation Report for Head TSL

Date: 20.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1078

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

Medium parameters used: f = 750 MHz; $\sigma = 0.88 \text{ S/m}$; $\epsilon_r = 42$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated. 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

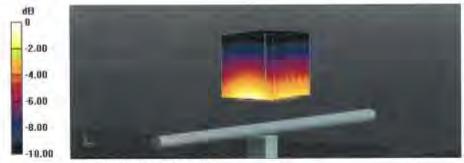
Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

DASY52 52,10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 60.18 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.21 W/kg

SAR(I g) = 2.13 W/kg; SAR(10 g) = 1.39 W/kgMaximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

Certificate No. D750V3-1075_Jun19

Page 5 of 8

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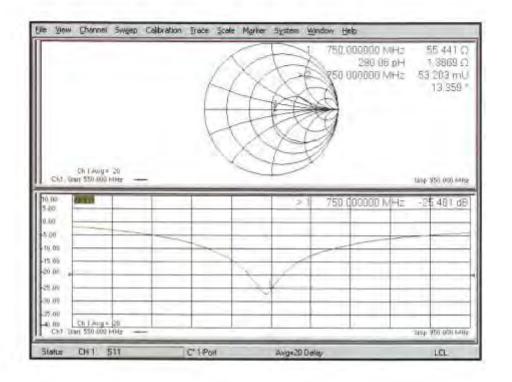
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Rev: 01

Page: 7 of 73

Impedance Measurement Plot for Head TSL



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Page 6 of 8

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Rev: 01

Page: 8 of 73

DASY5 Validation Report for Body TSL

Date: 27.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1078

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

Medium parameters used: I = 750 MHz; $\sigma = 0.96 \text{ S/m}$; $\epsilon_t = 55.5$; $\rho = 1000 \text{ kg/m}^2$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.4, 10.4, 10.4) @ 750 MHz; Calibrated: 29.05.2019

Sensor-Surface; 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

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

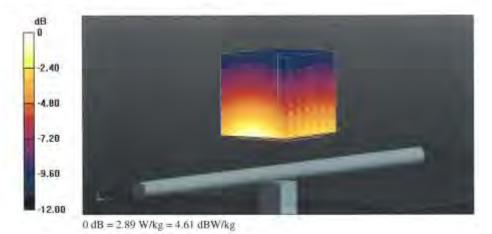
DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 55.85 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg

Maximum value of SAR (measured) = 2,89 W/kg



Certificate No: D750V3-1078_Jun19

Page 7 of 8

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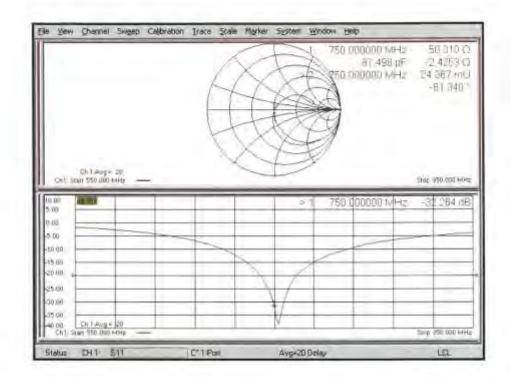
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Rev: 01

Page: 9 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D750V3-1078_Jun 19

Page 8 of 8

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Page: 10 of 73

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CALIBRATION (CERTIFICAT	E	
Dibject	D835V2 - SN:40	1092	
Contration procedure(s)	QA CAL-05.v11 Calibration Proc	edure for SAR Validation Source	es between 0.7-3 GHz
Calbration case:	June 20, 2019		
the transmission and the table	fled in this closed laborary	iloral islandards, which realize the physical or probability are given on the following pages a vry lociity: environment imporature (22 ± 4) ¹	and are part of the confecation
Primary Standards	iD#	Cal Date (Certificate No.)	Scheduled Californities
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02883(02893)	
Power sensor NRP-Z91	SN. 103244	D3-Apr-19 (No. 217-07692)	Apr-20 Apr-20
Power sensor NRF-Z91	SN 103245	03-Apr-19 (No. 217-02890)	Apr-20
Helerence 20 dB Afferwater	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
Releience Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349, May19)	May-20
	GN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
DWE4			0.00
	Tiria	Please Page 8 and 1	
Secondary Standards	ID 4 SN: GB39512478	Check Date (in house)	Scheduled Check
Secondary Standards Fower mater E4419B	SN: GB39512478	30-Oct-14 (in house check Fab-19)	It house check: Oct-20
Secondary Standards Fower mass: E4419B Power sensor HP 8481A	SN: GB39512478 SN: U537292783	30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18)	in house check: Oct-20 in house check: Oct-20
Secondary Standards Fower mater E4419B Power sensor HP 8461 A Power sensor HP 8461 A RF generator R&S SMT-06	SN: GB39512478	30-Oct-16 (in house check Feb-19) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	in house check: Oct-20 in house check: Oct-20 to house check: Oct-20
Secondary Standards Fower mater E44198 Power sensor HP 8461 A Power sensor HP 8461 A REGerendor R&S SMT-06	SN: GB39512478 SN: US37292783 SN: MY41092317	30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18)	in house check: Oct-20 in house check: Oct-20 in house check: Oct-20 in house check: Oct-20
Secondary Standards Fower mater E4419B Power sensor HP 8461 A Power sensor HP 8461 A RF generator R&S SMT-06	SN: GB39512478 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	30-Oct-14 (in house check Fati-19) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Non-15 (in house check Oct-16) 31-Mar-14 (in house check Oct-18)	in house check: Oct-20 in house check: Oct-20 in house check: Oct-20 in house check: Oct-20 in house check: Oct-18
Secondary Standards Fower Inster E4419B Power sersor HP 8461A Power sersor HP 8461A RF generator R&S SMT-06 Nétwork Analyzer Aglent E8568A	SN: I3839512478 SN: IJ637282783 SN: IJ637282317 SN: 100972 SN: IJ641080477 Name	30-Oct-14 (in house check Fab-19) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 31-Mar-1# (in house check Oct-18) Function	in house check: Oct-20 in house check: Oct-20 in house check: Oct-20 in house check: Oct-20
Secondary Standards Fower mater E4419B Fower sersor HP 8461A Fower sersor HP 8461A 15 generator R&S SMT-06 lietwork Analyzer Agrient E8568A	SN: GB39512478 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	30-Oct-14 (in house check Fati-19) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Non-15 (in house check Oct-16) 31-Mar-14 (in house check Oct-18)	In house check: Oct-20 in house check: Oct-20 to house check: Oct-20 in house check: Oct-20 in house check: Oct-18
Secondary Standards Fower mater E4419B Fower sensor HP 8461A Fower sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8568A Calibrated by	SN: I3839512478 SN: IJ637282783 SN: IJ637282317 SN: 100972 SN: IJ641080477 Name	30-Oct-14 (in house check Fab-19) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 31-Mar-1# (in house check Oct-18) Function	In house check: Oct-20 in house check: Oct-20 to house check: Oct-20 in house check: Oct-20 in house check: Oct-18
Secondary Standards Fower mater E4419B Power sensor HP 8461A Power sensor HP 8461A PE generator R&S SMT-06 Network Analyzet Agilent E856SA Calibratio by	SN: I3839512478 SN: IJ637282783 SN: IJ637282317 SN: 100972 SN: IJ641080477 Name	30-Oct-14 (in house check Fab-19) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 31-Mar-1# (in house check Oct-18) Function	In house check: Oct-20 in house check: Oct-20 to house check: Oct-20 in house check: Oct-20 in house check: Oct-18

Certificate No: D835V2-4d092_Jun19

Page 1 of H

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Rev: 01

Page: 11 of 73

Calibration Laboratory of Schmid & Partner Engineering AG Zevghamastrasse 43, 8004 Zunch, Switzerland





S Schweizerischer Kallbrierdiener
C Service bulsse d'étaionnage
Servizio evizzaro di fazanire
S Swiss Calibration Service

Accomitation No.: SCS 0108

According by the Swas Accordings Service (8A5).
The Swise Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates.

Glossary:

TSL

tissue simulating liquid

N/A

sensitivity in TSL / NORM x,y,z not applicable or not measured

Calibration is Performed According to the Following Standards:

 a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

 b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to B 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. 0835V2 4dg92_Jun19

Page 2 of 8

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Rev: 01

Page: 12 of 73

Measurement Conditions

DASY Version	DASY5	V52:10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phentum	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy dz = 5 mm	
Frequency	835 MHz = 1 MHz	

Head TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41816 =	0.91 mho/m ± 6 5
Head TSL temperature change during test	< 0.5 °C	_	

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	pormalized to 1W	9.50 W/kg = 17.0 % (k=2)

SAR averaged over 10 cm ² (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to fW	6.13 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	554±6 %	0.98 mno/m ± 5 %
Body TSL temperature change during test	< 0.5 °C	_	-

SAR result with Body TSL

SAR averaged over 1 cm2 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Body TSL parameters	normalizad to YW	9.57 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal flody TSL parameters	normalized to fW	5.24 W/kg = 16.5 % (k=2)

Certificate No: 0885V2-4d092_Jun19

Page 3 of 8

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Rev: 01

Page: 13 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 Q - 1.0 Q
Return Lass	-32.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	4630-730	
Return Loss	-21.5dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1,397 ns
	11001.100

After long firm use with 100W raciated 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-provided for DC-signals. On some of the dipoles, small and daps 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 ength 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

TAX TO A CONTRACT OF THE PARTY	
Manufactured by	SPEAG
The interest of the	SPEAG

Certilizate No: D835V2-4d092_Jun19

Page 4 ld 5

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Rev: 01

Page: 14 of 73

DASY5 Validation Report for Head TSL

Date: 20.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d092

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

Medium parameters used: f = 835 MHz; $\sigma = 0.91$ S/m; $\epsilon_i = 41.8$, $\rho = 1000$ kg/m¹

Phantom section: Flat Section

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

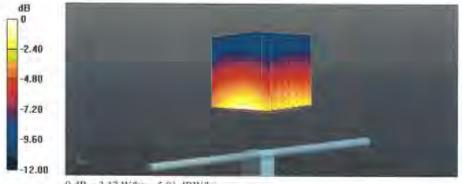
DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.89, 9.89, 9.89) @ 835 MHz, Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04 2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid; dx=5mm, dy=5mm, dz=5mm Reference Value = 63.07 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.60 W/kg

SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.54 W/kgMaximum value of SAR (measured) = 3.17 W/kg



0 dB = 3.17 W/kg = 5.01 dBW/kg

Certificate No. D835V2-4d092_Jun19

Page 5 of 8

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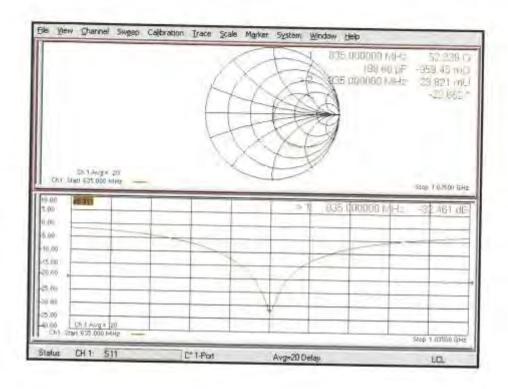
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Rev: 01

Page: 15 of 73

Impedance Measurement Plot for Head TSL



Certificate No. D835V2-4d092_Jun19

Page 6 of 8

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Rev: 01

Page: 16 of 73

DASY5 Validation Report for Body TSL

Date: 19.06.2019

Test Luboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d092

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

Medium parameters used: f = 835 MHz; $\sigma = 0.98 \text{ S/m}$; $c_r = 55.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

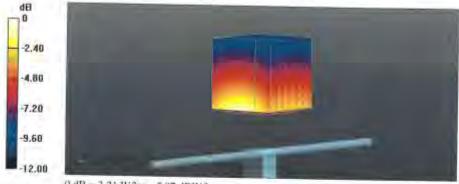
- Probe: EX3DV4 SN7349; ConvF(10.16, 10.16, 10.16) @ 835 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52,10,2(1504); SEMCAD X 14,6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 58.23 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.61 W/kg

SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.57 W/kgMaximum value of SAR (measured) = 3.21 W/kg



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

Gertificate No: D835V2-4d092 Jun 19

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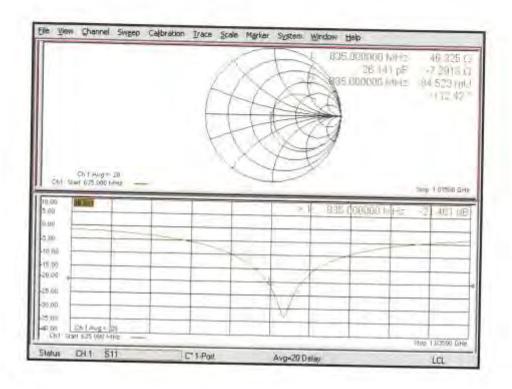
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Rev: 01

Page: 17 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d092_Jun19

Page 8 of 8

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Rev: 01

Page: 18 of 73

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





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Accremitation No.: SCS 0108

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Certificate No: D1750V2-1023 Jun19

Shiaci	D1750V2 - SN:10	023	
Situmbon procedurets)	QA CAL-05.v11 Calibration Proce	adure for SAR Validation Sources	between 0.7-3 GHz
Telibration date	June 20, 2019		
The measurements and the present	aintius with confidence p	ional standards, which realize the physical un archaeliky and given my the following pages an my tackity: investment temperature (22 ± 3)*C	d see part of the sattificate
Calibration Equipment used (MATE	colles for calibration)		
Primary Standards	10 v	Cai Data (Certificani No.)	Screduled Cashration
Ower meter NETP	SN: 104778	03-Apr-18 (No. 217-02892/02893)	Apr-20
gwer sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apri-20
	SN: 103245	03-Apr-16 (No. 217-02863)	Am-29
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ower sensor NRP-Z91	SN: 5058 (20k)	04 Apr-19 (No. 217-02894)	Apr-20
ower sensor NRP-Z9r elerence 20 dB Attenuator ype-N inversatch combination		04 Apr-19 (No. 217-02894) 04 Apr-19 (No. 217-02895)	Apr-20 Apr-20
ower sensor NRP-Z9r elemnce 20 dB Attenuator ype-N insimatch combination elemence Probe EXSOV4	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	04 Apr 19 (No. 217-02894) 04 Apr 19 (No. 217-02895) 29 May 19 (No. EX3-7349, May 19)	Apr-20 Apr-20 May-20
ower sensor NRP-291 desence 20 dB Attenuator yps-N insmatch combination leterence Probe EXSOV4	SN: 5058 (20k) SN: 5047.2 / 06327	04 Apr-19 (No. 217-02894) 04 Apr-19 (No. 217-02895)	Apr-20 Apr-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N invariantch combination Reference Probe EXSOV4 DAE#	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	04 Apr 19 (No. 217-02894) 04 Apr 19 (No. 217-02895) 29 May 19 (No. EX3-7349, May 19)	Apr-20 Apr-20 May-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N inversatch combination feliverence Probe EXSOV4 DAE# Secondary Standards Power instar E#419B	SN: 5058 (20k) SN: 5047.2 / 05327 SN: 504 SN: 604 ID 4 SN: 5853951297b	04 Apr-18 (No. 217-02894) 04 Apr-19 (No. 217-02895) 29 May-19 (No. EX3-7349 May-19) 30-Apr-19 (No. DAE-4-601 Apr19) Oheck Date-(in house) 30-00-74 (in house check Feb-19)	Apr-20 Apr-20 May-20 Apr-20 Schaduled Check to follow phock: Oct-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N invernatch combination reference Probe EXSOV4 DAE4 Secondary Standards Power massr E4419B Power sensor HP 8481A	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 601 ID 4 SN: 58539512878 SN: US37292783	04 Apr 18 (No. 217-02894) 04 Apr 19 (No. 217-02895) 29 May 19 (No. EX3-7349, May 19) 30 Apr 19 (No. DAEA-601, Apr 19) Check Date (In house) 30-0ct-14 (In house check Peb-18) 07-0ct-16 (in house check Oct-18)	Apr-20 Apr-20 May-20 Apr-20 Schaduled Check to house check: Oct-20 In house check: Oct-20
Power sensor NRP-ZEr Reference 20 dB Attenuator Type-N insernatch combination seference Probe EXSOV4 DAE/I Secondary Standards Power maker E4413B Power sensor HP 8481A	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID 4 SN: 5659512476 SN: US37292783 SN: MY41082317	04 Apr 18 (No. 217-02894) 05 Apr 19 (No. 217-02895) 29-May-19 (No. EX3-7349, May19) 30-Apr-19 (No. DAEA-601, Apr19) Check Date (In house) 30-Oct-14 (in house check Peb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-20 Apr-20 May-20 Apr-20 Schaduled Check to house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Power sensor NRP-ZEr Actesince 20 dB Attenuator Type-N invariants combination Reference Probe EXSOV4 JAE4 Secondary Standards Power masser E4419B Power consor HP B481A Power sensor HP B481A RF generator HP B481A	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 (0.4 SN: 58599512879 SN: US37296783 SN: MY41062317 SN: US37296783	04 Apr 18 (No. 217-02894) 04 Apr 19 (No. 217-02895) 29-May-19 (No. EX3-7349 May19) 30-Apr-19 (No. DAEA-601 Apr19) Check Date (In house) 30-00-74 (In house check Peb-19) 07-00-15 (In house check Oct-18) 07-00-15 (In house check Oct-18) 15-Jun-19 (In house check Oct-18)	Apr-20 Apr-20 May-20 Apr-20 Schaduled Check In house check: Oct-20
Power sensor NRP-ZEr Actesince 20 dB Attenuator Type-N invariants combination Reference Probe EXSOV4 JAE4 Secondary Standards Power masser E4419B Power consor HP B481A Power sensor HP B481A RF generator HP B481A	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID 4 SN: 5659512476 SN: US37292783 SN: MY41082317	04 Apr 18 (No. 217-02894) 05 Apr 19 (No. 217-02895) 29-May-19 (No. EX3-7349, May19) 30-Apr-19 (No. DAEA-601, Apr19) Check Date (In house) 30-Oct-14 (in house check Peb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-20 Apr-20 May-20 Apr-20 Schaduled Check to house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Power sensor NRP-291 Actenance 20 dB Attenuator Type-N insenstch combination Reference Probe EXSOV4 DAS4 Secondary Standards Power maser EH419B Power maser EH419B Power sensor HP 8481A Power sensor HP 8481A RE generates HP 8481A RE generates HP 8481A	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 (0.4 SN: 58599512879 SN: US37296783 SN: MY41062317 SN: US37296783	04 Apr 18 (No. 217-02894) 04 Apr 19 (No. 217-02895) 29-May-19 (No. EX3-7349 May19) 30-Apr-19 (No. DAEA-601 Apr19) Check Date (In house) 30-00-74 (In house check Peb-19) 07-00-15 (In house check Oct-18) 07-00-15 (In house check Oct-18) 15-Jun-19 (In house check Oct-18)	Apr-20 Apr-20 May-20 Apr-20 Schaduled Check In house check: Oct-20
Power sensor NRP-Zer Reference 20 dB Attenuator Type-N inversatch combination Reference Probe EXSOV4 DAE4 Secondary Standards Power masser E4419B Power sensor HP B481A RE generator HP B481A	SN: 5058 (20k) SN: 5047.2 / 05327 SN: 7349 SN: 601 (D.# SN: GB39512879 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477	04 Apr-19 (No. 217-02894) 04 Apr-19 (No. 217-02895) 29 May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAEA-661_Apr19) Check Date (In house) 30-00-74 (in house check Feb-19) 07-0ct-16 (in house check Oct-18) 07-0ct-16 (in house check Oct-18) 15-dun-15 (in house check Oct-18) 31-May-14 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Sohaduled Check In house check: Oct-20 In house check: Oct-10
Power sensor NRP-Z91 Reference 20 dB Attenuator Type- N mismatch combination feliverics Probe EXSOV4 DAE4 Secondary Standards Power maser E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator H&S SMT-08 Redwork Analyzer Agilent E8358A	SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 601 ID # SN: GB39512870 SN: US37292783 SN: MV41082317 SN: 100972 SN: US41080477	04 Apr-19 (No. 217-02894) 04 Apr-19 (No. 217-02895) 29 May-19 (No. EX3-7349, May19) 30-Apr-19 (No. DAE-4-601, Apr19) Oheck Date-(in house) 30-00-74 (in house check Peb-19) 07-0ct-16 (in house check Oct-18) 07-0ct-16 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-May-14 (in house check Oct-18) 31-May-14 (in house check Oct-18)	Apr-20 Apr-20 May-20 Apr-20 Schadulad Check to house check: Oct-2 In house check: Oct-2 In house check: Oct-2 In house check: Oct-2 In house check: Oct-1

Certificate No: D1750V2-1023_Jun19

Page t of 8

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Rev: 01

Page: 19 of 73

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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial. Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1. Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- EC 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: D1750V2-1023 Jun19

Page 2 of 8

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Rev: 01

Page: 20 of 73

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx. dy, dz = 5 mm	
Frequency	1750 MHz = 1 MHz	

Head TSL parameters

	Temperature	Parmittivity	Conductivity
Nominal Head TSL parameters	22,0 °C	40.1	1.37 mba/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.0±5%	1.34 mbo/m ± 6 %
Head TSL temperature change during test	≥ 0.5 °C	-	-

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Egedibas	
SAR measured	250 mW input power.	8.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm2 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	18.9 W/kg ± 16.5 % (k=2)

Body TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.8) °C	53.9 ± 6 %	1.46 mbo/m ± 6
Body TSL temperature change during test	< 0.5 °C		7-11-1

SAR result with Body TSL

SAR averaged over 1 cm2 (1 g) of Body TSL	Condition	
SAFI measured	250 mW Input power	9.23 W/kg
SAR for nominal Body TSL parameters	normalized in 1W	37.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.8 W/kg ± 16.5 % (k=2)

Certificate No: D1750V2-1023 Junt 9

Page 3 of 8

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Rev: 01

Page: 21 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

impedance, transformed to feed point	50.3 (1 - 8.1 (4)
Return Loss	- 50.0 dB

Antenna Parameters with Body TSL

Impedance, framsformed to feed point	46.4 () - 1.0 (()
Return Loss	- 28.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.218 ns
----------------------------------	----------

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

The dipole is made of standard semingid coaxial pable. The center conductor of the feeding (one is circotly connected to this second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On come of this dipoles, small end caps are added to the dipole arms in order to improve matching when leaded according to the position as explained in the "Measurement Conditions" peragraph. 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 circule arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

William Control of the Control of th	
Manufactured by	SPEAG

Certificate No D1750V2-1025_Jun19

Page 4 of 8

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Rev: 01

Page: 22 of 73

DASY5 Validation Report for Head TSL

Date: 19.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1023

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

Medium parameters used: f = 1750 MHz; $\sigma = 1.34 \text{ S/m}$; $\epsilon_n = 40$: $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 29.05.2019

Sensor-Surface: (4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

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

DASY52 52 10.2(1504); SEMCAD X 14.6.12(7470)

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

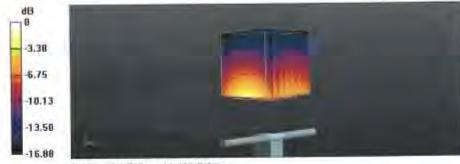
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.5 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 8.9 W/kg; SAR(10 g) = 4.69 W/kg

Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

Certificate No: D1750V2-1023 Jun19

Page 5 of 8

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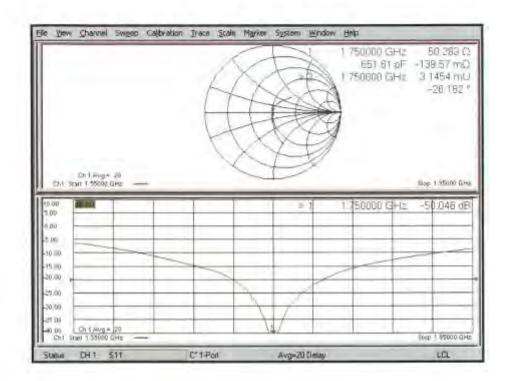
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Rev: 01

Page: 23 of 73

Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-T023 Jun19

Page 6 of 8

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Rev: 01

Page: 24 of 73

DASY5 Validation Report for Body TSL

Date: 20.06.2019

Test Laboratory: SPEAG, Zunch, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1023

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

Medium parameters used: f = 1750 MHz; $\alpha = 1.46 \text{ S/m}$; $\epsilon_r = 53.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.45, 8.45, 8.45) @ 1750 MHz; Calibrated: 29.05.2019

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 102.7 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 16.5 W/kg

SAR(1 g) = 9.23 W/kg; SAR(10 g) = 4.91 W/kg

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



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

Certificate No: D1750V2-1023 Jun19

Page 7 of 8

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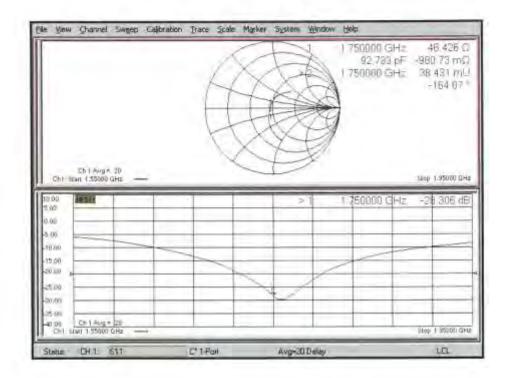
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Rev: 01

Page: 25 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1023 Jun19

Page 8 of 8

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Rev: 01

Page: 26 of 73

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Certificate No: D1900V2-5d142 Jul19 Auden

CALIBRATION CERTIFICATE D1900V2 - SN:5d142 Cower QA CAL-05.v11 Calemanon precedurates Calibration Procedure for SAR Validation Sources between 0.7-3 GHz July 26, 2019 Californion date: The calibration certificate documents the trace of the financial standards, which realize the physical units of measurements (SIY. 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 classed laboratory facility: environment temperature (22 ± 3) °C and humility < 70% Calibration Equipment used (MATE critical for calibration) Primary Standards Cal Date (Certificate No.) Scheduled Calibration SN: 104776 09 Apr-19 (No. 217-02892/02893) Apr-20 Power maker NRP Power sensor NRP-Z91 SN: 103244 03-Apr-19 (No. 217-02692) Apr-20 Fower sensor NRP-Z91 5N 103245 03-Apr 19 (No. 217-02893) Apr-20 Raterance 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. 217-03895) Apr-20. Reference Probe EX3DV4 SN: 7349 29-May-19 (No. EX3-7349 May-10) May-20 DAE4 SN: 901 30-Apr-19 (No. DAE4-601_Apr19) Apr 20 Secondary Standards ID N Check Date (in house) Scheduled Check Fower mater E4419B SN GB39512475 30-Clci-14 (ir. house check Fab-19) In house check: Oct-20. Power sensor HF 8461A SN US37292783 07-Oct-15 (in house check Oct-18) in house check: Old-20 Power sensor HP 8461A SN MY41092317 07-Out-15 (in house check Clot-18) In resupe check: Clef-20. RF generator R&S SMT-0tt SN 100972 15-Jun-15 (in house check Oct-18) In nausa check: Oct 40 Network Analyzer Apilent EB358A SN. US41080477 in muse check: Oct-19. 31-May-14 (in house check Oct-18) Calibrated by: Claudio Laubier Laboratory Technician Katja Pokovic Technical Manage Approved by: leaved July 26, 2019 This calibration certificate shall not be reproduced except in full without written approve of the laboratory

Certificate No: D1900V2-50142 Jul 19

Page 1 of 8

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Rev: 01

Page: 27 of 73

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





Schweizeriacher Kalibrierdinnei Service sulless d'étatornage. Servizio svizzaro di taratura Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swas Accreditation Service (SAS)

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Glossarv:

TSL tissue simulating liquid

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

Calibration is Performed According to the Following Standards:

- 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 3D 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%

Cartificate No: 01900V2-5e142 Jul 19

Page 2 of 6

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Rev: 01

Page: 28 of 73

Measurement Conditions

DASY Version	DASY5	V52 10.2
Extrapolation	Advanced Extrapplation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spaper
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were appli

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22,0 °C	40,0	1.40 mino/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.5 ± 11 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	≤05°C		-

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) at Head TSL	Condition	
SAR measured	250 mW input power	9,94 W/kg
SAR for nominal Mead TSL parameters	normalized to 1W	40.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	gondition	
SAR measured	250 mW input power	5,22 W/kg.
SAR for nominal Head TSL parameters	normalized to 1W	21.2 W/kg = 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mha/m
Measured Body TSL parameters	(22,0±0,2) °C	54.7 ± 6.%	1.48 inho/m ± 6 %
Body TSL temperature change during test	<0,5 °C	-	****

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.77 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ⁴ (10 g) of Body TSL	contidion	
SAR measured	250 mW input power	5.17 W/kg
SAF for hominal Body TSL parameters	normalized to 1W	20.9 W/kg ± 16.5 % (k±2)

Certificate No. D1900V2-5d142 Jul19

Page 3 of 8

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Rev: 01

Page: 29 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

impedance, transformed to feed point	51 T 12 + 5.3 js2
Return Lass	- 25.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point-	48.7 (4 + 6.5 (1)	
Return Loss	- 23.5 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 ns
electrical chilay (one direction)	7. 100 He

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 feetling line is directly connected to the second aim of the dipole. The ansema is therefore short-circuited for DC-signals. On some of this 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 must the feedpoint may be damaged

Additional EUT Data

Manufactured by	SPEAG
The Control of the Co	

Civilisate No. D1900V2-5rt142 Jul19

Page 4 of B

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Rev: 01

Page: 30 of 73

DASY5 Validation Report for Head TSL

Date: 26.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d142

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

Medium parameters used: f = 1900 MHz; $\sigma = 1.37 \text{ S/m}$; $\varepsilon_r = 41.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.44, 8.44, 8.44) @ 1900 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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 = 110.3 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 18.4 W/kg SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.22 W/kg

Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

Certificate No: D1900V2-5d142_Jul19

Page 5 of 6

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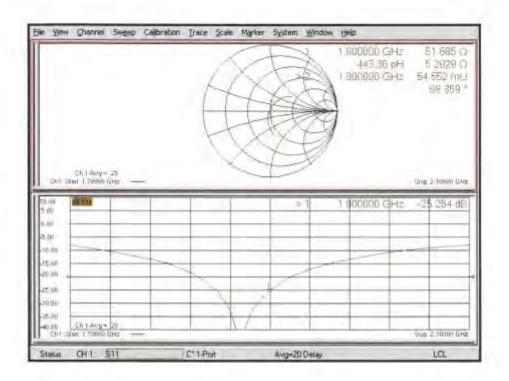
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Rev: 01

Page: 31 of 73

Impedance Measurement Plot for Head TSL



Certificate No. 01900V2-5d142 Jul 19

Page 5 of 8

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Rev: 01

Page: 32 of 73

DASY5 Validation Report for Body TSL

Date: 26.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d142

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

Medium parameters used: f = 1900 MHz; $\sigma = 1.48 \text{ S/m}$; $\varepsilon_r = 54.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349: ConvF(8,42, 8,42, 8,42) @ 1900 MHz; Calibrated: 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

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

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.1 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 17.5 W/kg

SAR(1 g) = 9.77 W/kg; SAR(10 g) = 5.17 W/kgMaximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dBW/kg

Certificate No: D1900V2-5d142_Jul19

Page 7 of 8

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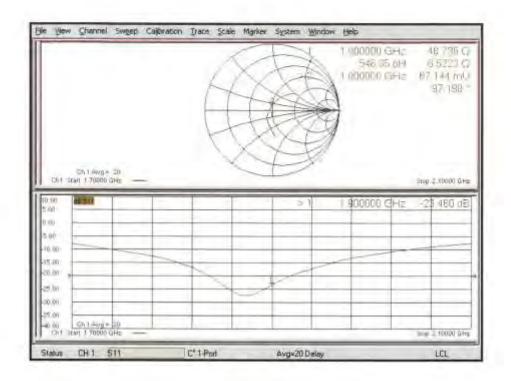
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Rev: 01

Page: 33 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d142_Jul19

Page 8 of 8

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Page: 34 of 73

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





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Accredant by the Swas Ancredomon Service (SAS) Accreditation No.: SCS 0108 The Swiss Accreditation Service is one of the signatories to the EA. Multilateral Agreement for the recognition of calibration certificates

Auden Certificate No: D2300V2-1092 Dec18

	ERTIFICATI	E	
Otijed	D2300V2 - SN:1092		
Calification procedure(a)	QA CAL-05 v10 Calibration procedure for dipole validation kits above 700 MHz		
Carbiation date	December 04, 2018		
The mississurements and the uncer All certifications have been sonouc	taktina with confidence p	nional standards, which resize the physical in probability are given on the following pages ar my facility: environment temperature (22 ± 3)*	nd are part of the certificate.
Calibration Equipment used (M&T	100000000000000000000000000000000000000	When you do not	0.000
Primary Standards Power Inster NRP	EN ADAMA	Gal Date (Certificate filo.)	Scheduled Calbration
	SN: 104778	04-Apr-18 (No. 217-02672/02073)	
The second secon	The second second		Apr-10
ower sensor NRP-291	SN 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91	SN 103244 SN 103245	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673)	Apr-19 Apr-19
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103244 SN: 103245 SN: 5058 (20k)	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682)	Apr-19 Apr-19 Apr-19
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Amenusion Type-N marmatch compressor	SN 103244 SN 103245 SN: 5058 (20k) SN: 5047 2 / 06327	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683)	Apr-19 Apr-19 Apr-19 Apr-19
Power sensor NRP-291 Power sensor NRP-281 Reference 30 dB Amenusion Type-M mismatch comparation Reference Probe EX3DV4	SN: 103244 SN: 103245 SN: 5058 (20k)	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682)	Apr-19 Apr-19 Apr-19
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Amenustor Type-N mismatch comprostion Reference Probe EX3DV4 IAE4	SN 103244 SN 103245 SN: 5058 (20k) SN: 5047 2 / 06327 SN: 7349	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 30-Dec-17 (No. EX3-7349 Dec17) 04-Oct-16 (No. DAE4-801 Dig18)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Och 19
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Americator Type-N member compressor Reference Probe EX3DV4 TAE4 Secondary Standards	SN: 103244 SN: 103245 SN: 5088 (20k) SN: 5047 2 / 06327 SN: 7849 SN: 601	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349 Dec17) 04-Oct-15 (No. DAE4-801 Dot18) Check Cate (in house)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Clot-19 Eicheduled Check
Power sensor NRP-291 Power sensor NRP-291 Reterence 20 dB Americation Type-N member comprision Reterence Probe EX3DVA TABLE Becondary Schmards Power meter EPM-442A	SN: 103244 SN: 103245 SN: 5038 (20k) SN: 5047 2 / 16527 SN: 7349 SN: 501	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349 Dec17) 04-Oct-16 (No. DAE4-801 De18) Check Date (in house)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Gichoduled Check In house (heck, Oct-20)
Power sensor NRP-291 Power sensor NRP-291 Helemence 20 dB Amenistror Type-N mematich comprisation Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 103244 SN: 103245 SN: 5038 (20k) SN: 5047 2 / 06327 SN: 7349 SN: 601	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349 Dec17) 04-Oct-15 (No. DAE4-801 Dot18) Check Cate (in house)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Och 19 Scheduled Check In house check: Oct-20 In himse check: Oct-20
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Amenuator type-N mismatch consciration televence Probe EX3DV4 1AE4 Secondary Samueras Power mater EPM-442A Power sensor HP 8481A	SN: 103244 SN: 103245 SN: 5038 (20k) SN: 5047 2 / 06327 SN: 7349 SN: 601 ID # SN: GE37480704 SN: US37292783	04-Apr-16 (No. 217-02672) 04-Apr-16 (No. 217-02672) 04-Apr-16 (No. 217-02682) 04-Apr-16 (No. 217-02682) 04-Apr-16 (No. 217-02683) 04-Oct-17 (No. EX3-7349, D6c17) 04-Oct-16 (No. DAE4-801, Dc118) Check Date (in house) 07-Oct-16 (in house check Oct-16) 07-Oct-16 (in house check Oct-16) 07-Oct-16 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Ameniator Type-N mismatch compristion Reference Probe EX3DV4 RAE4 Secondary Samdards Power sensor HP 8481A Power sensor HP 8481A RE generator H8 S SMT-08	SN: 103244 SN: 103245 SN: 5088 (20k) SN: 5047 2 / 06527 SN: 7349 SN: 601 SN: G837480704 SN: US37292783 SN: WY41098317 SN: 100972	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349, Dec17) 04-0ct-15 (No. DAE4-801, Oct18) 05-0ct-15 (in house) 07-0ct-15 (in house check Oct-18) 07-0ct-15 (in house check Oct-18) 07-0ct-15 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Dec-18 Och/19 Eicheduled Chedu In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Ameniation Type-M mammatich comparation Reference Probe EX3DV4 DAE4 Secondary Standards Power mater EPM-442A Power sensor HP 8461A Power sensor HP 8461A RF genersor HP 8451A RF genersor H8 S SMT-06 MATERICK Analyzer Aglent EB308A	SN: 103244 SN: 103245 SN: 5085 (20k) SN: 5047 2 / 46527 SN: 7349 SN: 601 JD # SN: GE37480704 SN: US37292783 BN: WY41080317 SN: 100972 SN: US41080477	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349 Dec17) 04-Oct-15 (No. DEC4-801 De18) Check Date (in house) 07-Oct-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Americator Type-N marmatch comprostor Reference Probe EX30V4 RAE4 Power sensor HP 8481A Power sensor HP 8481A RE generator HP 8481A	SN: 103244 SN: 103245 SN: 5088 (20k) SN: 5047 2 / 06527 SN: 7349 SN: 6837480704 SN: US37292783 SN: US37292783 SN: US372927783 SN: US37292777 SN: 100977 SN: US37292777 SN: US37292777	04-Apr-16 (No. 217-02672) 04-Apr-16 (No. 217-02682) 04-Apr-16 (No. 217-02682) 04-Apr-16 (No. 217-02682) 04-Apr-16 (No. EX3-7349 Dec17) 04-Oct-16 (No. DAE4-801 Det18) 05-Oct-16 (No. DAE4-801 Det18) 07-Oct-16 (No. Dae4-801 Det18) 15-Jun-16 (No. Dae4-801 Det18) 15-Jun-16 (No. Dae4-801 Det18) 15-Jun-16 (No. Dae4-801 Det18) 15-Jun-16 (No. Dae4-801 Det18) 16-Jun-16 (No. Dae4-801 Det18)	Apr-19 Apr-19 Apr-19 Dec-18 Oct-19 Scheduled Check In house check: Oct-20
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Ameniation Type-M mammatich comparation Reference Probe EX3DV4 DAE4 Secondary Standards Power mater EPM-442A Power sensor HP 8461A Power sensor HP 8461A RF genersor HP 8451A RF genersor H8 S SMT-06 MATERICK Analyzer Aglent EB308A	SN: 103244 SN: 103245 SN: 5088 (20k) SN: 5047 2 / 06527 SN: 7349 SN: 601 SN: 6837480704 SN: US37292783 SN: MY41082317 SN: 190972 SN: US41080477 Name	04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349 Dec17) 04-Oct-18 (No. DAE4-801 Oct18) 07-Oct-18 (In house check Oct-18) 07-Oct-18 (In house check Oct-18) 07-Oct-18 (In house check Oct-18) 15-Jun-16 (In house check Oct-18) 31-Mat-14 (In house check Oct-18)	Apr-19 Apr-19 Apr-19 Dec-18 Och-19 Scheduled Check In house check: Oct-20

Certificate No: D2300V2-1092_Dec18

Page 1 of 8

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Rev: 01

Page: 35 of 73

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S Schweizenscher Kaubnerdien
C Service suisse dietzionnage
Servizio sylzzero di lanatura
S Bwiss Calibration Service

Accreditation No.: SCS 0108

Accretized by the Swas Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signaturies to the EA
Multisabral Agreement for the recognition of calibration certification

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.
- 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.
- BAR 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. D2300V2-1092_Dec19

Page 2 of B

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Rev: 01

Page: 36 of 73

Measurement Conditions

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Fat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dk. 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 mha/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38 3 ± 6 %	1.70 mho/m ± 6 h
Head TSL temperature change during test	< 0.5 °C	_	

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAH measured	250 mW input power	12.5 W/kg
SAR for nominal Head TSL parameters	normalized in 1W	49.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 ℃	52.9	1.81 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	1.85 mha/m ± 6 %
Body TSL temperature change during test	c0.5 C	-	-

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Candillori	
SAR measured	250 mW input power	12.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	47.2 W/kg ± 17,0 % (k=2)

SAR averaged over 10 cm ² (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.74 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.7 W/kg = 16.5 % (k=2)

Certificate No. D2300V2-1092 Dec18

Page 3 of 8

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Rev: 01

Page: 37 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	508 \O - 3.1 \O	
Return Loss	- 30.0 dB	

Antenna Parameters with Body TSL

Impedancy, Immsformed to feed point.	46.6 11 + 2 9)()
Return Loss	- 26.7 dB

General Antenna Parameters and Design

The state of the s	
Electrical Delay (one direction)	1 164 ns
and an including the control of the	1 104 149

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 26, 2018

Certificate No: D2300V2-1092_Dec18

Page 4 of 8

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Rev: 01

Page: 38 of 73

DASY5 Validation Report for Head TSL

Date: 03.12.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1092

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

Medium parameters used: f = 2300 MHz; $\sigma = 1.7 \text{ S/m}$; $\varepsilon_r = 38.3$; $\rho = 1000 \text{ kg/m}$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.08, 8.08, 8.08) @ 2300 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1,4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial; 1001
- DASY52 52:10.2(1495); SEMCAD X 14.6.12(7450)

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 = 116.8 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 24.6 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 6.01 W/kgMaximum value of SAR (measured) = 20.4 W/kg



0 dB = 20.4 W/kg = 13.10 dBW/kg

Certificate No: D2300V2-1092_Dec18

Page 5 of 8

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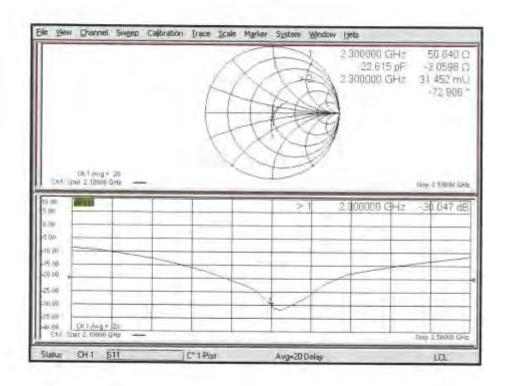
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Rev: 01

Page: 39 of 73

Impedance Measurement Plot for Head TSL



Certificate No: D2300V2-1092_Dec16

Page 6 of 8

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Rev: 01

Page: 40 of 73

DASY5 Validation Report for Body TSL

Date: 04.12.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1092

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

Medium parameters used: f = 2300 MHz; $\sigma = 1.85 \text{ S/m}$; $\varepsilon_t = 51.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.08, 8.08, 8.08) @ 2300 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 108.0 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 23.2 W/kg

SAR(1 g) = 12 W/kg; SAR(10 g) = 5.74 W/kgMaximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

Certificate No: D2300V2-1092_Dec16

Page 7 of 8

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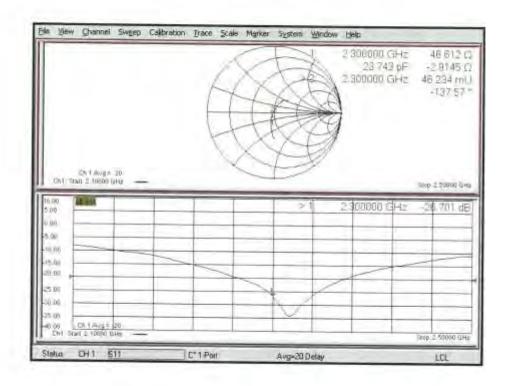
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Rev: 01

Page: 41 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D2300V2-1092_Dec18

Page 8 of 8

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Rev: 01

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Certificate No: D2450V2-869 Jun 19

CALIBRATION CERTIFICATE D2450V2 - SN:869 Calibration procedure(s) QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz June 27, 2019 Call invition date: This calibration cartilicate documents the tracescript to natureal standards, which reases the physical suns of measurements (51) The measurements and the uncertainties with confidence probability are given on the following pages and are part of the confidence Af calibrations have been conducted in the closed laboratory facility, environment temperature (22 ± 01°C and humidity < 70%). Calibration Equipment uses (M&TE critical for calibration) D.s. Primary Standards Cal Disse (Certificate No.) Schedued Calibration Power moter NRP SN-104778 03 Apr 18 (No. 217-02882/02893) April 0 Power sensor NRP-291 SN 103244 03-Apr-19 (No. 217-02892) Apr.20 Power sensor NRP-291 BN-103245 03-Apr-19 (No. 217-02893) Att-20 Reference 20 dB Attenuator SN 5058 (20k) 0#-Apr-19 (No. 217-02894) Apr.20 Type-N mismatch domnination BW 5047.2 / 06327 04-Apr-19 (No. 217-02895) Apr-20 Remience Probe EX3DV4 SN 7349 29-May-19 (No. EX3-7349_May19) May-20 SN: 501 30-Apr-19 (No. DAE4-801_Apr19) Apr-20 D+ Scheduled Check Secondary Standards Check Date (in house) Powermeter E44193 SW GB39512475 30-Oct-14 (in house chuck Feb-19) in house check: Oct 20 Power season HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-16) In house check. Oct 20 Power sensor HP 8481A 5N MY41092317 (17-Oct-15 (in House check Oct-18) in house check. Oct-20 RF generator R&S SMT-66 SN 100972 15-Jun-15 (in house check Oct-18) In house check Oct-20 Network Analyzer Agilent E8358A SN US41090477 31-Mar-14 (in house check Oct-18) tv muse creek: Oct-19 Michael Weber Cashirated by: Laboratory Technician Katja Poković Technical Manager Approved by Issued June 27, 2019 This collection certificate shall not be reproduced except in full without written approval of the laboratory

Certificate No: D2450V2-969 Jun19

Page 1 of 8

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Rev: 01

Page: 43 of 73

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





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Accreditation No.: SCS 0108

According by the Swiss Accordination Service (SAS)

The Swiss Accreditation Service is one of the signatures to the EA Multilaters Agreement for the recognition of calibration certification

Glossarv:

tissue almulating liquid TSL 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 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: 02450V2-989 Jun 19

Page 2 at 8

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Rev: 01

Page: 44 of 73

Measurement Conditions

DASY Version	DASY5	V52 10.2
Extrapolation	Advanced Extrapolation	
Phentom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	cox, cly, cl2 = 5 min	
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 mbo/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	179±6%	1.86 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		1000

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAFI measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.35 W/kg
SAR for nominal Head TSL parameters	normalized to TW	25.1 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) C	51.0 ± 8 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	≥0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm2 (1 g) of Body TSL	Condition	
SAR measured	250 mW Input power	13,3 W/kg
SAR for nominal Body TSL parameters	normalized to TW	51.8 W/kg ± 17.0 % (ks/2)

SAR averaged over 10 cm ² (10 g) of Body TSL	condition	
SAFI measured	250 mW input power	6.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.5 W/kg ± 16.5 % (k=2)

Certificate No: D2450V2-869_Jun19.

Page 3 of 8

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Rev: 01

Page: 45 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9 Ω = 6.4 Ω
Refurn Loss	23.4 dB

Antenna Parameters with Body TSL

Impedance transformed to feed point	48 7 (1 + 8,3 1)
Return Loss	- 21.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns

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

The dipole is made of standard serringid coaxial cable. The center conductor of the leeding line is directly connected to the second arm of the dipole. The antenna is therefore short-proutled for DC-signals, On some of the dipoles, small and 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 hedpoint may be damaged

Additional EUT Data

Manufactured by	SPEAG
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Page X of 8

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Rev: 01

Page: 46 of 73

DASY5 Validation Report for Head TSL

Date: 27:06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:869

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

Medium parameters used: f = 2450 MHz; $\sigma = 1.86 \text{ S/m}$; $\epsilon_r = 37.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.9, 7.9, 7.9) @ 2450 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30,04,2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10,2(1504); SEMCAD X 14.6.12(7470)

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 = 117.5 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 27.0 W/kg SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.35 W/kg

Maximum value of SAR (measured) = 22.2 W/kg



0 dB = 22.2 W/kg = 13.46 dBW/kg

Certificate No: D2450V2-869_Jun19

Page 5 of 8

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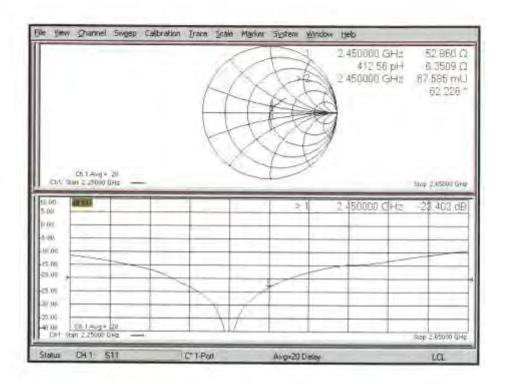
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Rev: 01

Page: 47 of 73

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-869_Jun19

Page 5 of 8.

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Rev: 01

Page: 48 of 73

DASY5 Validation Report for Body TSL

Date: 27.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:869

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

Medium parameters used: f = 2450 MHz; $\sigma = 2.03 \text{ S/m}$; $c_r = 51$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe; EX3DV4 SN7349; ConvF(7.94, 7.94, 7.94) @ 2450 MHz; Calibrated: 29.05.2019.
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Senal: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 109.2 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 25.9 W/kg SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.22 W/kg

Maximum value of SAR (measured) = 21.3 W/kg



Certificate No: D2450V2-869_Jun19

Page 7 at 8

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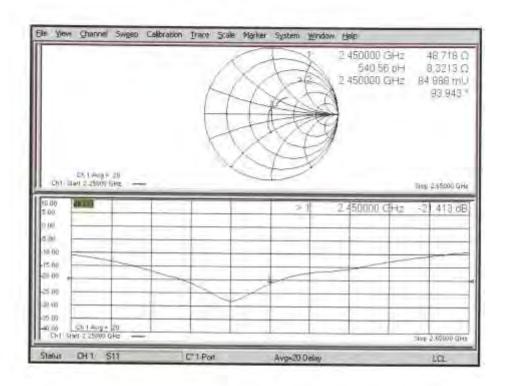
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Rev: 01

Page: 49 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-869_Jun19

Page 8 of 8

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Rev: 01

Page: 50 of 73

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STALL PRINCIPLE	ERTIFICAT	Ę	
Object	D2600V2 - SN:1	058	
Celbration procedures:	QA CAL-05.v11 Calibration Proc	edure for SAR Validation Sources	s between 0.7-3 GHz
Calibration date	June 27, 2019		
The massirements and the uncer	tamss with confidence;	tionel standards, which review the physical or probability are given on the following pages as any tability environment temperature (22 \pm 3):	nd era part of the semilicate.
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Power matter NRIP-ZB1 Power sensor NRIP-ZB1 Power sensor NRIP-ZB1 Reference 20 dB Assanuator Fuller in mattratich comprission Reference Probe EXSDV4 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047:2 / 06327 SN: 7349 SN: 601	03-Apr-19 (No. 217-02992/02903) 03-Apr-19 (No. 217-02992) 03-Apr-19 (No. 217-02993) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02995) 29-May-19 (No. EX3-7349 May18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-80 Scheduled Check
Power mater NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Assanuaror Power mismatch compressor Reference Probe EXSDV4 DAE4 Recondary Standards Power mater E4419H Power sensor HP B481A	SN 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	03-Apr-19 (No. 217-02992)0293) 03-Apr-19 (No. 217-02992) 03-Apr-19 (No. 217-02993) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. EX3-7349 May18) 30-Apr-19 (No. DAE4-601, Apr19)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20
tower meter NRP Tower sensor NRP-Z91 Tower sensor NRP-Z91 Selemence 20 dB Attanuary Type-N mismatch componition Idelecence Probe EXSDV4 IAE4 econdary Standards Tower meter E4410H Tower sensor HP 8461A	SN 103244 SN: 103245 SN: 5058 (20k) SN: 5057 2 / 06327 SN: 7349 SN: 601	03-Apr-19 (No. 217-02992)0393) 03-Apr-19 (No. 217-02992) 03-Apr-19 (No. 217-02993) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. EX3-7349 Mey18) 30-Apr-19 (No. DAE-4-601_Apr19) Check Date (in house chack Feb-19)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Scheduled Check In house check: Oct-2 In house check: Oct-2
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ower meter NRP-ZB1 dwer sensor NRP-ZB1 dwer sensor NRP-ZB1 deer sensor NRP-ZB1 deer sensor NRP-ZB1 deference 20 dB Assaulage ype-N mismalch composition deference Probe EXSDV4 AE4 econdary Standards Ower meter E4410H ower sensor HP 8481A User sensor HP 8481A Figensrator H&S SMT-06	SN 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 (G # SN: GB39612475 SN: US37292783 SN: MY41092317	03-Apr-19 (No. 217-02892)0393) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349 May-18) 30-Apr-19 (No. EX3-7349 May-18) 07-Apr-19 (No. EX3-7349 May-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check Oct-2
Power meter NRP-Z91 Cower sensor NRP-Z91 Cower sensor NRP-Z91 Cower sensor NRP-Z91 Cower meter EXSDV4 Cower meter EXSDV4 Cower meter EXHIBH Cower sensor HP 8481A Cower sensor HP 8481A Cower sensor HP 8481A	SN 103244 SN: 103245 SN: 5038 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 IG # SN: GB39612475 SN: US37282783 SN: MY41032317 SN: 100272 SN: US41090677	03-Apr-19 (No. 217-02992)03903) 03-Apr-19 (No. 217-02992) 03-Apr-19 (No. 217-02993) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. EX3-7349 Mey18) 30-Apr-19 (No. DAE4-601 Apr19) 07-0ct-14 (in house check Oct-16) 07-0ct-15 (in house check Oct-18) 11-Mar-14 (in house check Oct-18)	Apr-20 Ap
ower meter NRP Ower sensor NRP-ZB1 Ower sensor NRP-ZB1 Ower sensor NRP-ZB1 Ower meter EXSDV4 AE4 Ower meter E4410B Ower sensor HP B481A F generator R&S SMT-06 elsern Analyzer Agitent E0368A	SN 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 UD # SN: GB38512475 SN: US37282763 SN: MY41092377 SN: 106972 SN: US41090677	03-Apr-19 (No. 217-02992)03903) 03-Apr-19 (No. 217-02992) 03-Apr-19 (No. 217-02993) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. EX3-7349 Mey18) 30-Apr-19 (No. EX3-7349 Mey18) 07-Oct-14 (In house check Oct-18) 07-Oct-15 (In house check Oct-18) 11-Mar-14 (In house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check Oct-2
Power meter NRIP-Z81 Power sensor NRIP-Z81 Power sensor NRIP-Z81 Reference 20 dB Assanuary Poye-N mismatich comprission Reference Probe EXSDV4 JAE4 Recondary Standards Power sensor HP 8481A Receivers Analyzer Agitent E8588A	SN 103244 SN: 103245 SN: 5038 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 IG # SN: GB39612475 SN: US37282783 SN: MY41032317 SN: 100272 SN: US41090677	03-Apr-19 (No. 217-02992)03903) 03-Apr-19 (No. 217-02992) 03-Apr-19 (No. 217-02993) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. EX3-7349 Mey18) 30-Apr-19 (No. DAE4-601 Apr19) 07-0ct-14 (in house check Oct-16) 07-0ct-15 (in house check Oct-18) 11-Mar-14 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-80 Scheduled Check In house check Oct-2/ In house check Oct-2/ In house check Oct-2/ In house check; Oct-2/ In house check; Oct-1/
Pontary Standards Power service NRIP Power service NRIP-291 Power service NRIP-291 Power service NRIP-291 Reference 20 dB Attanuarde Type-N misurialish combination Reference Probe EXSQV4 DAE4 Secondary Standards Power meter E4418B Power service HP 8481A Power service HP 8481A Power service HP 8481A Power service HP 8481A Reference Analyzer Agillent E8588A Calibrated by	SN 103244 SN 103245 SN 5058 (20k) SN 50472 / 06327 SN 7349 SN 601 IG # SN GB38512475 SN US\$7292783 SN MY41092317 SN 100972 SN US41080677 Name	03-Apr-19 (No. 217-02892)0393) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349 Mey18) 30-Apr-19 (No. EX3-7349 Mey18) 31-Mar-14 (No. Exa-60 Apr-19) 15-Jun-15 (No. Exa-60 Apr-19) 15-Jun-15 (No. Exa-60 Apr-19) 15-Jun-14 (No. Exa-60 Apr-19) 15-Jun-15 (No. Exa-60 Apr-19) 15-Jun-15 (No. Exa-60 Apr-19) 15-Jun-16 (No. Exa-60 Apr-19) 15-Jun-16 (No. Exa-60 Apr-19) 15-Jun-17 (No. Exa-60 Apr-19) 15-Jun-18	Apr-20 Ap
Power sensor NRP-281 Power mismatic comprision Reference 20 dB Assandary Power Model E44188 Power model E44188 Power sensor HP 8481A Power sensor HP 8481A Prower sensor HP 8481A	SN 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 UD # SN: GB38512475 SN: US37282763 SN: MY41092377 SN: 106972 SN: US41090677	03-Apr-19 (No. 217-02992)03903) 03-Apr-19 (No. 217-02992) 03-Apr-19 (No. 217-02993) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. 217-02994) 04-Apr-19 (No. EX3-7349 Mey18) 30-Apr-19 (No. EX3-7349 Mey18) 07-Oct-14 (In house check Oct-18) 07-Oct-15 (In house check Oct-18) 11-Mar-14 (In house check Oct-18)	Apr-20 Ap

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Page 1 of 8

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Rev: 01

Page: 51 of 73

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





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Service gulisse d'étalonnege
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S Bwiss Galibration Service

Ammeditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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Glossary:

TSL

tissue simulating liquid

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No D2600V2-1058 Jun 19

Page 2 of 8

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Rev: 01

Page: 52 of 73

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	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	1.90 mbo/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37 3 = 6 %	2.03 mho/m = 6 %
Head TSL temperature change during test	< 0.5 °C	_	-

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	th 9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	58.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.59 W/kg
SAR for numitral Head TSL parameters	nomisked to TW	26,0 W/kg ± 16,5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22,0 "C	52.5	216 mhoim
Measured Body TSL parameters	(82.0 ± 0.2) °C	50.5 ± 6 %	2.22 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW Input power	14.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	55.0 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6;39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W.	25.2 W/kg ± 16.5 % (k=2)

Certificate No: D2600V2-1058_Jun19

Page 3 of 8

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Rev: 01

Page: 53 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, Iransformed to feed point	48.2 £1 - 6.9 £2
Fletum Loss	-22 8 dB

Antenna Parameters with Body TSL

Impedance, transformed to fend point	45.5 Ω - 5.2 μΩ
Return Loss	- 22 9 dB

General Antenna Parameters and Design

At the Asset of the second of	
Electrical Delay (one direction)	1.150 ns
1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	LIDUTE.

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

The dipole is made of standard semingid costons 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

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Manufactured by	SPEAG
	1411 14 TOTAL

Certificate No: D2600V2-1058_Jun 19

Page 4 of 8

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Rev: 01

Page: 54 of 73

DASY5 Validation Report for Head TSL

Date: 27.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type; D2600V2; Serial: D2600V2 - SN:1058

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

Medium parameters used: f = 2600 MHz; $\sigma = 2.03 \text{ S/m}$; $v_r = 37.3$; $p = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

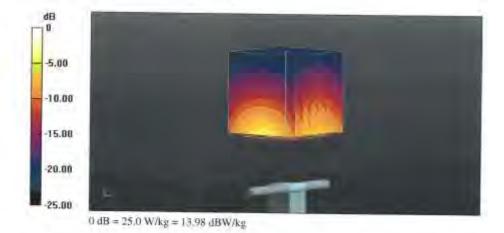
DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.69, 7.69, 7.69) @ 2600 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04,2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52,10.2(1504); SEMCAD X 14.6.12(7470).

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 = 120.6 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 30.0 W/kg SAR(1 g) = 14.9 W/kg; SAR(10 g) = 6.59 W/kg

Maximum value of SAR (measured) = 25.0 W/kg



Certificate No: D2600V2-1058_Jun19

Page 5 of 8

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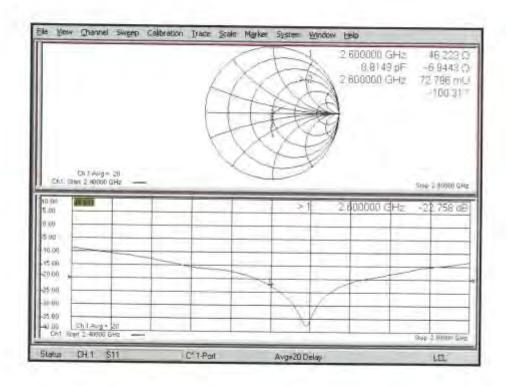
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Rev: 01

Page: 55 of 73

Impedance Measurement Plot for Head TSL



Certificate No: D2600V2-1058_Jun19

Page 8 of 8

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Rev: 01

Page: 56 of 73

DASY5 Validation Report for Body TSL

Date: 27.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type; D2600V2; Serial: D2600V2 - SN:1058

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

Medium parameters used: f = 2600 MHz; $\alpha = 2.22$ S/m; $\epsilon_r = 50.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.8, 7.8, 7.8) @ 2600 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52/10/2(1504); SEMCAD X 14.6 12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 110.1 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 29.0 W/kg SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.39 W/kg

Maximum value of SAR (measured) = 23.6 W/kg



Certificate No: D2600V2-1058_Jun19

Page 7 of 8

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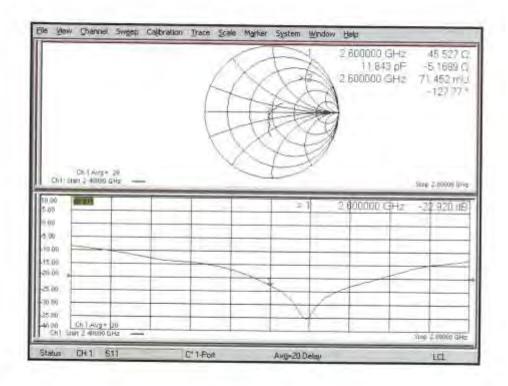
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Rev: 01

Page: 57 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D2600V2-1058_Jun19

Page 8 of 8

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Rev: 01

Page: 58 of 73

Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43. 9004 Zurich, Switzerland





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Auden

Certificate No. D5GHzV2-1040_Jun19

	ERTIFICAT	E	
Object	D5GHzV2 - SN:	1040	
Calitavisido procedure(s)	OA CAL-22.v4 Calibration Proc	edure for SAR Validation Sources	s between 3-6 GHz
Calibration days	June 24, 2019		
The misesillements and the Lnos	transes will confidence :	tional scandards, which realize the physical or probability are given on the following pages are my bodity, environment temperature (22 ± 3)*	nd ma part of the certificate
Printery Standards	in e	Ca) Date (Certificate No.)	Scheduled Contration
Power meter NRP Power sensor NRP-281 Power sensor NRP-291 Reference 20 dB Attenuetor	SN 104778 SN 103244 SN: 103245 SN 5058 (204) 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-18 (No. 217-02894) 04-Apr-19 (No. 217-02895)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Mar-20
Fyre-N mismetch combination Reference Probe EXXDV4	5N 3503 5N: 601	25-Mar-19 (No. EX3-3503_Mar19) 30-Apr-19 (No. DAE4-601_Apr19)	Apri-20
Type-4 mismisch combination Reference Probe EX30V4 DAE4	Service de	90-Apr-19 (No. DAE4-601 April4)	Agn-20
Fyim-N mismetch combination Reference Probe EXSCV4 DAE4 Secondary Standards Power mater E44195 Power sensor HP 8481A Fromer sensor HP 8481A RF generator RAS SMT-06	SN: 601 SN: GB38512475 SN: US37292783 SN: WY41092317 SN: 100972		Apr-90 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Fype-N mismesch combination Reference Probe EXSOVA DAE4 Secondary Standards Power mater E44195 Power sensor HP 8481A Power sensor HP 8481A RF generator P&S SMT-Oo	SN: 601 SN: GB38512475 SN: US37292783 SN: WY41092317 SN: 100972	30-Apr-19 (No. DAE4-601 April4) Check Date (in house) 30-Oct-14 (in house check Fabi-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19
Fyre-N mismetch combination Reference Probe EXXDV4	SN: 601 SN: GB38512475 SN: US3/292783 SN: MY41092317 SN: 100972 SN: US41080477	30-Apr-19 (No. DAE4-601 April4) Check Date (in house) 30-Oct-14 (in house check Fabi-19) D7-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-90 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Fyiiw-N mismetich combination Reference Probe EXSCV4 DAEs Secondary Standards Power mater E44195 Power sensor HP 8481A Power sensor HP 8481A HF generator R&S SMT-0o Network Analyzer Agreet E8358A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	30-Apr-19 (No. DAE4-601. Aprill) Check Date (in house) 30-Oct-14 (in house check Fati-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Man-14 (in house check Oct-18) Function	Scheduled Check In house check: Oct-20 In house check: Oct-19

Certificate No: D5GHzV2-1040 Jun 19

Page 1 of 16

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Rev: 01

Page: 59 of 73

Calibration Laboratory of Schmid & Partner

Engineering AG Zaughausstrasse 43, 8004 Zorich, Switzerland





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Accreditation No.: SCS 0108

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Glossary:

TSL

lissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM k,y,z not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, 'Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30. MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms priented 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 leed 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. D5GHzV2-1040 Jun19

Page 2 of 16

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Rev: 01

Page: 60 of 73

Measurement Conditions

DASY Version	DASY5	V52.10.2
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 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calcula

	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	35.5 ± 6 %	4.47 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	7.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1040_Jun19

Page 3 of 16

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Rev: 01

Page: 61 of 73

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	35.3 ± 6 %	4.57 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (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)

Head TSL parameters at 5500 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35,6	4.96 mha/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 6 %	4.77 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-He	****

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.7 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1040_Jun19

Page 4 of 16

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Rev: 01

Page: 62 of 73

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	34.9 ± 6 %	4.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	

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	8.52 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.8 W/kg ± 19.9 % (kw2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 19.5 % (k=2)

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	34.6 ± 6 %	5.08 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 ² (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	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (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)

Certificate No: D5GHzV2-1040_Jun19

Page 5 of 16

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Rev: 01

Page: 63 of 73

Body TSL parameters at 5200 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.6 ± 6 %	5.43 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	****	

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.38 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm2 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.4 ± 6 %	5.56 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		1

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1040_Jun19

Page 6 of 16

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Rev: 01

Page: 64 of 73

Body TSL parameters at 5500 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.83 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		****

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

ACCOUNT OF THE PROPERTY OF THE	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.97 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7,94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.6 W/kg ± 19.5 % (k=2)

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Page 7 of 16

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Rev: 01

Page: 65 of 73

Body TSL parameters at 5800 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	6.25 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	****	

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ² (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1040 Jun19

Page 8 of 16

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Rev: 01

Page: 66 of 73

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	48.9 Ω - 8.7 Ω	
Return Loss	- 21,0 dB	

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.7 Ω - 5.2 Ω	
Return Loss	- 25.2 dB	

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.9 Ω - 1.7 jΩ	
Return Loss	- 32.1 dB	

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.0 Ω - 0.7 ΙΩ
Return Loss	- 28.1 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.8 Ω - 2.6 jΩ	
Return Loss	- 23.4 dB	

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	50.9 Ω - 6.2 jΩ	
Return Loss	- 24.1 dB	

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.9 Ω - 2.2 jΩ	
Return Loss	- 32.2 dB	

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.6 Ω - 3.7 μΩ	
Return Loss	- 28.7 dB	

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	59.2 Ω - 1.2 Ω	
Return Loss	- 21.4 dB	

Certificate No: D5GHzV2-1040_Jun19

Page 9 of 16

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Rev: 01

Page: 67 of 73

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	55.1 Ω - 0.6 Ω	
Return Loss	- 26.3 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 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

Catagoria - Az alberta participano	
Manufactured by	SPEAG

Certificate No: D5GHzV2-1040_Jun19

Page 10 of 16

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Rev: 01

Page: 68 of 73

DASY5 Validation Report for Head TSL

Date: 21.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 4.47 \text{ S/m}$; $\varepsilon_t = 35.5$; $\rho = 1000 \text{ kg/m}$ Medium parameters used: f = 5300 MHz; $\sigma = 4.57 \text{ S/m}$; $\varepsilon_r = 35.3$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: f = 5500 MHz; $\sigma = 4.77 \text{ S/m}$; $\epsilon_r = 35$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5600 MHz; $\sigma = 4.88 \text{ S/m}$; $\epsilon_r = 34.9$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5800 MHz; $\sigma = 5.08 \text{ S/m}$; $\epsilon_r = 34.6$; $\rho = 1000 \text{ kg/m}^2$ Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.64, 5.64, 5.64) @ 5200 MHz, ConvF(5.39, 5.39, 5.39) @ 5300 MHz, ConvF(5.1, 5.1, 5.1) @ 5500 MHz, ConvF(4.95, 4.95, 4.95) @ 5600 MHz, ConvF(4.96, 4.96, 4.96) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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 = 75.53 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 17.7 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 = 77.14 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 8.28 W/kg; SAR(10 g) = 2.37 W/kg

Maximum value of SAR (measured) = 18.9 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,

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

Reference Value = 75.85 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 32.2 W/kg

SAR(1 g) = 8.39 W/kg; SAR(10 g) = 2.38 W/kg

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

Certificate No: D5GHzV2-1040 Jun 19

Page 11 of 16

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Rev: 01

Page: 69 of 73

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 = 76.89 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 8.52 W/kg; SAR(10 g) = 2.43 W/kg

Maximum value of SAR (measured) = 20.0 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 = 74,05 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 32.1 W/kg

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

Maximum value of SAR (measured) = 19.5 W/kg



0 dB = 19.5 W/kg = 12.90 dBW/kg

Certificate No: D5GH2V2-1040_Jun19

Page 12 of 16

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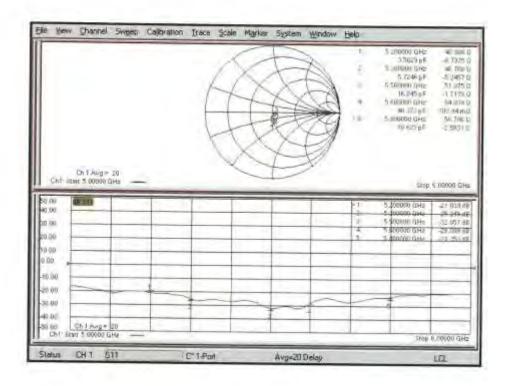
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Rev: 01

Page: 70 of 73

Impedance Measurement Plot for Head TSL



Certificate No. D5GHzV2-1040 Jun 19

Page 13 of 16

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Rev: 01

Page: 71 of 73

DASY5 Validation Report for Body TSL

Date: 24.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz,

Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: f = 5200 MHz; $\sigma = 5.43 \text{ S/m}$; $\varepsilon_r = 47.6$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5300 MHz; $\sigma = 5.56$ S/m; $\varepsilon_r = 47.4$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5500 MHz; $\sigma = 5.83 \text{ S/m}$; $\varepsilon_r = 47$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5600 MHz; $\sigma = 5.97 \text{ S/m}$; $\epsilon_r = 46.8$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5800 MHz; $\sigma = 6.25 \text{ S/m}$; $\varepsilon_r = 46.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.14, 5.14, 5.14) @ 5200 MHz, ConvF(5.25, 5.25, 5.25) @ 5300 MHz, ConvF(4.79, 4.79, 4.79) @ 5500 MHz, ConvF(4.74, 4.74, 4.74) @ 5600 MHz, ConvF(4.62, 4.62, 4.62) @ 5800 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body 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 = 68.41 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.4 W/kg

SAR(1 g) = 7.38 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 17.5 W/kg

Dipole Calibration for Body 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 = 66.48 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 28.5 W/kg

SAR(1 g) = 7.33 W/kg; SAR(10 g) = 2.06 W/kg

Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,

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

Reference Value = 67.29 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 32.3 W/kg

SAR(1 g) = 7.80 W/kg; SAR(10 g) = 2.16 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

Certificate No: D5GHzV2-1040 Jun19

Page 14 of 16

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Rev: 01

Page: 72 of 73

Dipole Calibration for Body 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 = 66.90 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 33.6 W/kg

SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.23 W/kgMaximum value of SAR (measured) = 19.6 W/kg

Dipole Calibration for Body 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 = 65,04 V/m; Power Drift = -0.04 dB

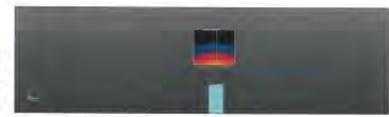
Peak SAR (extrapolated) = 32.3 W/kg

dB

6.00 12.00 -18.00 24.00 30.00

SAR(1 g) = 7.44 W/kg; SAR(10 g) = 2.07 W/kg

Maximum value of SAR (measured) = 18.8 W/kg



0.dB = 17.5 W/kg = 12.43 dBW/kg

Certificate No: D5GHzV2-1040_Jun79

Page 15 of 18.

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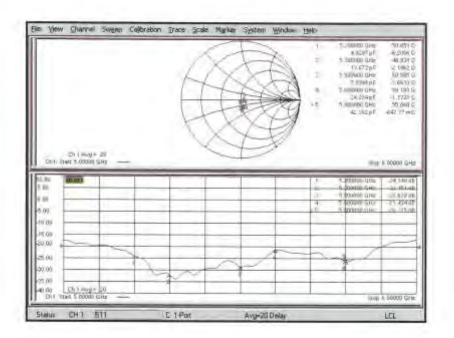
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Rev: 01

Page: 73 of 73

Impedance Measurement Plot for Body TSL



Certificate No: D6GHzV2-1040_Jun19

Page (6 of 16

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