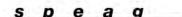


Appendix C

Phantom Description

Schmid & Partner Engineering AG



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

Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 5.0	
Type No	QD OVA 002 A	
Series No	1108 and higher	
Manufacturer	Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland	

Tests

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

Test	Requirement	Details	Units tested
Shape	Internal dimensions, depth and sagging are compatible with standards	Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for f > 375 MHz	Prototypes
Material thickness	Bottom: 2.0mm +/- 0.2mm	dimension compliant with [3] for f > 800 MHz	all
Material parameters	rel. permittivity 2 – 5, loss tangent ≤ 0.05, at f ≤ 6 GHz	rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05	Material samples
Material resistivity	Compatibility with tissue simulating liquids .	Compatible with SPEAG liquids. **	Phantoms, Material sample
Sagging	Sagging of the flat section in tolerance when filled with tissue simulating liquid.	within tolerance for filling height up to 155 mm	Prototypes, samples

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

Standards

- 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-heid and body-mounted wireless communication devices Human models, instrumentation, and procedures Part 1: [3] 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 [4]

Conformity

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 Date

Signature / Stamp

eag L& Partner Engineering AG Sestrass 43, 8004 Zulch. Shishriand 441 44245 9718 Fext 44 64 5 9779

Doc No 881 - QD OVA 002 A - A

Page 1(1)

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t (886-2) 2299-3279 台灣檢驗科技股份有限公司

www.tw.sas.com

Member of SGS Group



System Validation from Original Equipment Supplier

Engineering AG eugheusstrasse 43, 8004 Zurich	/ of , Switzerland		Service mines d'étalements
Accredited by the Swiss Accredital The Swiss Accreditation Service Nottilateral Agreement for the re	is one of the signatorie	asi to the EA	Accreditation No.: SCS 0108
SGS-TW (Aude	n)	Certificate N	te: D750V3-1015_Aug18
CALIBRATION C	ERTIFICATE	E	
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Calibration Laboratory of Schmid & Partner Engineering AG usttrasse 43, 8004 Zurich, Switzerland



S C S

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Accreditation No.: SCS 0108

Accessived by the Swisa Accreditation Service (SAS) The Swiss Aboreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration pertilicates Glossary:

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

Callbration 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%

Certilicate No: D760V3 1015 Aug18

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Measurement Conditions

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

DASY Version	DASY5	V52.10,1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, d2 = 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	40.9 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.23 W/kg ± 17.0 % (k=2)
107 book to (n.61) (no.01 true beneraue RAS	osaditina	
SAR averaged over 10 cm ¹ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ¹ (10 g) of Head TSL SAR measured	condition 250 mW input power	1.34 W/kg

Body TSL parameters

The following parameters and calculations were applied,

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55,5	0.98 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.0±6%	0.96 mho/m ± 8 %
Body TSL temperature change during test	< 0.5 °C	-	

SAR result with Body TSL

SAR averaged over 1 cm ² (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	8.62 W/kg = 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL.	condition	
	condition 250 mW input power	1.43 W/kg

Certificate No. D750V3-1015 Aug16

Page 3 of 8

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Imperdance, transformed in faed point	53.4 <i>k</i> 2 + 0.0 βΩ
Return Loss	- 29.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 JJ - 3.6 JD
Return Loss	- 27.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.037 ns
Linear isan branky (orna sanatanishi)	1.0.37 18

After long term use with HOOW rediated 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-orcuited for DC-signals. On some of the dipoles, small and capa 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 cipole arms, because they might bend or the soldered connections near the leedpoint may be damaged

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 22, 2010

Certificate No: D750V3-1015_Aug16

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DASY5 Validation Report for Head TSL

Date: 22.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.89 \text{ S/m}$; $v_r = 40.9$; $p = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439) .

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 59.12 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 3.11 W/kg SAR(1 g) = 2.07 W/kg; SAR(10 g) = 1.34 W/kg Maximum value of SAR (measured) = 2.77 W/kg



0 dB = 2.77 W/kg = 4.42 dBW/kg

Certificate No: D750V3-1015 Aug 18

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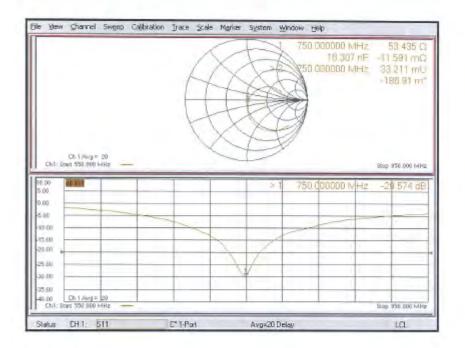
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Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1015_Aug18

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DASY5 Validation Report for Body TSL

Date: 23.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

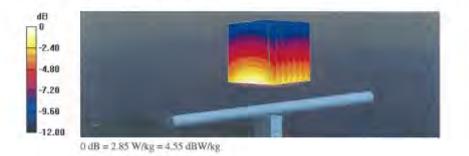
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.96$ S/m; $\epsilon_r = 55$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: L4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017 .
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439) .

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 57.93 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.17 W/kg SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.43 W/kg Maximum value of SAR (measured) = 2.85 W/kg



Certificate No: D750V3-1015_Aug18

Page 7 of 8

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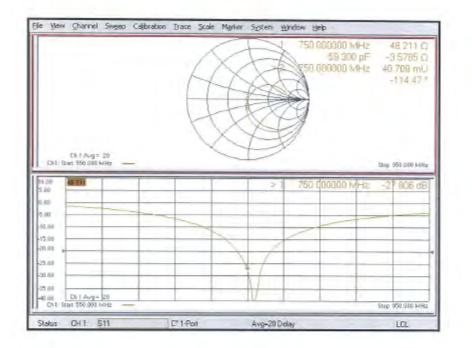
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Impedance Measurement Plot for Body TSL



Certificate No: D750V3-1015 Aug18

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ccredited by the Swiss Accreditation he Swise Accreditation Service i ultilateral Agreement for the rec	is one of the signatorie	es to the EA	ccreditation No.: SCS 0108
CALIBRATION C	·		o: D835V2-4d063_Aug18
ALIDRATION CI	ENTIFICATI	-	
Disject	D835V2 - SN:4d	063	
Calibration procedure(s)	QA CAL-05.v10 Calibration proce	edure for dipole validation kits ab	ove 700 MHz
Calibration cale:	August 23, 2018		
Calibration Equipment used (M&TE		ry facility; environment temperature (22 \pm 3)*	G and humidity < 70%.
Calibration Equipment used (M&TE Primary Standards	E critical for celloration)	Cal Date (Camfronte No.)	Schedured Calibration
Calibration Equipment used (M&TE Primary Standards Power meter NRP	critical for celloration) ID # SN: 104778	Cai Daté (Ciamficate No.) 04-Apr-15 (No. 217-02672)02673)	Scheduled Calibration
Calibration Equipment used (M&TE Primary Standards Yower meter NTP Power sensor NTP-201	Ecritical for cellbration) ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02872)02673) 04-Apr-18 (No. 217-02672)	Scheduled Calibration Apr-19 Apr-19
Calibration Equipment used (M&TE Primary Standards Yower meter NRP Yower sensor NRP-281 Power sensor NRP-281	critical for cellocation) ID # SN: 104778 SN: 10244 SN: 103245	Cal Date (Cemficate No.) 04-Apr-16 (No. 217-02672)02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673)	Scheduled Calibration Apr-19 Apr-19 Apr-19
Calibration Equipment used (M&TE Primary Standards *ower meter NRP *ower sensor NRP-201 *ower sensor NRP-201 Telerence 20 dB Attenuator	critical for cellocation) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Cale (Camilcate No.) 04-Apr-15 (No. 217-02672)02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02672) 04-Apr-16 (No. 217-02612)	Scheduled Calibration Apr-19 Apr-19 Apr-18
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Reterance 20 dB Attenustor Type-N misuratch combination	critical for cellocation) 10 # SN: 104778 SN: 102244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	Cal Daté (Camfronte No.) 04-Apr-15 (No. 217-02072/02673) 04-Apr-15 (No. 217-02672) 04-Apr-16 (No. 217-02673) 04-Apr-16 (No. 217-02682) 04-Apr 15 (No. 217-02682)	Scheduled Calibration Apr-19 Apr-19 Apr-18 Apr-18 Apr-19
Calibration Equipment used (M&TE Primary Standards *ower meter NRP *ower sensor NRP-281 *ower sensor NRP-281 Telerence 20 dB Attenuator (ype-M meteratich combination *eterance Probe EX3DV4	critical for cellocation) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Cale (Camilcate No.) 04-Apr-15 (No. 217-02672)02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02672) 04-Apr-16 (No. 217-02612)	Scheduled Calibration Apr-19 Apr-19 Apr-18
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Reterance 20 dB Attenustor (ypp-N misuratich combination Reterance Probe EX30V4 DAE4 Secundary Standards	critical for oditionation) 10 # SN: 104778 SN: 103244 SN: 103245 SN: 5068 (20k) SN: 5068 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 10 #	Cal Daté (Camficate No.) 04-Apr-15 (No. 217-02672)02573) 04-Apr-15 (No. 217-02672) 04-Apr-16 (No. 217-02673) 04-Apr-16 (No. 217-02683) 04-Apr-16 (No. 217-02683) 30-Dac-17 (No. EX3-7349_Dac-17) 26-Ocl-17 (No. DAE4-601_Oct17) Check Date (in house)	Scheduled Calibration Apr-19 Apr-19 Apr-18 Apr-18 Dats-18 Dats-18 Dats-18 Dats-18 Dats-18 Dats-18 Dats-18
Calibration Equipment used (M&TE 2nimary Standards 2nwer meter NRP 2nwer sensor NRP-201 2nwer sensor NRP-201 Petersore 20 dB Atenuator Yop-N misumatch combination Retaining Probe EX3DV4 DAE4 Securidary Standards 2nwer mater EPM-448A	critical for ostionation) ID # SN: 104778 SN: 103245 SN: 3058 (20k) SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 601 ID # SN: 6B37480704	Cal Daté (Centificate No.) 04-Apr-18 (No. 217-02872)02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02683) 04-Apr-18 (No. 217-02683) 30-Dac-17 (No. EXS-7349_Dec17) 26-Oct-17 (No. DAE+601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-18 Apr-18 Dec-18 Dec-18 Det-18 Det-18 Scheduled Check In house check: Oct-18
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-281 Reference 20 dB Attenustor Type-N mismatich combination Relationce Probe EX30V4 DAE4 Secundary Standards Power meter EPM-442A Power meter EPM-442A Power sensor HP S481A	critical for celloration) ID # SN: 104776 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5057 2 / 06327 SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 601 ID # SN: 6B37490704 SN: US37292783	Cal Date (Certificate No.) 04-Apr-16 (No. 217-02672)/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 202-7348_Dac-17) 26-Oct-17 (No. DAE+601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Scheduled Calibration Apr-19 Apr-19 Apr-18 Apr-18 Apr-18 Data-18 Oct-18 Scheduled Check In house check: Oct-18 in house check: Oct-18
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-281 Power sensor NRP-281 Reference 20 dB Attenustor Type-N mismatch combination Relatence Probe EX30V4 DAE4 Secundary Standards Power meter EP14.442A Power sensor HP \$481A Power sensor HP \$481A	critical for celloration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 96327 SN: 5047.2 / 96327 SN: 5047.2 / 9 SN: 601 ID # SN: 6837490704 SN: 0537292783 SN: MY41082317	Car Daté (Cemficate No.) 04-Apr-16 (No. 217-02672)02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 30-Dac-17 (No. EXS-7349_Dec-17) 26-Oct-17 (No. EXS-7349_Dec-17) 26-Oct-17 (No. DAE-4-601_Oct17) Check Date (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-18 Apr-18 Dat-18 Det-18 Det-18 Scheduled Check In house check: Oct-18 in house check: Oct-18 in house check: Oct-18
Calibration Equipment used (M&TE Primary Standards: Power meter NRP- Power sensor NRP-201 Power sensor NRP-201 Heterance 20 dB Attenuator (ypo-N mismatch combination Heterance Probe EX30V4 DAE4 Secondary Standards Power meter EPM-442A Power meter EPM-442A Power meter EPM-442A Power sensor HP 8401A TF generator R&S SMT-06	Critical for odibration) ID # SN: 104778 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5058 (20k) SN: 5072 / 06327 SN: 7349 SN: 601 ID # SN: 6B37490704 SN: 6B37490704 SN: 404082317 SN: 106972	Cal Daté (Camficate No.) 04-Apr-16 (No. 217-02872/02873) 04-Apr-18 (No. 217-02872) 04-Apr-18 (No. 217-02872) 04-Apr-18 (No. 217-02882) 30-Dac-17 (No. EX3-7349, Dac-17) 26-Oct-17 (No. EX3-7349, Dac-17) 26-Oct-17 (No. DAE-4-601_Oct-17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Data-18 Data
Calibration Equipment used (M&TE Primary Standards Power meter NRP-201 Power sensor NRP-201 Reference 20 dB Attenustor Type-N misematich combination Reterence Probe EX30V4 DAE4 Secundary Standards Power meter EPM4442A Power meter EPM4442A Power sensor HP 3401A RF ganerator R&S SMT-06	critical for cellocation) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 7349 SN: 601 ID # SN: 0837490704 SN: 0837292783 SN: Mr44082317 SN: 10541080477	Cal Date (CentRote No.) 04-Apr-16 (No. 217-02872/02873) 04-Apr-18 (No. 217-02872) 04-Apr-18 (No. 217-02872) 04-Apr-18 (No. 217-02802) 04-Apr-18 (No. 217-02802) 04-Apr-18 (No. 217-02883) 30-Dac-17 (No. EX3-7349_Dec-17) 26-Oct-17 (No. DAE+601_Oct17) Check Date (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-17)	Scheduled Calibration Apr-19 Apr-19 Apr-18 Apr-18 Data
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-281 Reterance 20 dB Atenustor Type-N mismatich combination Retatance Proba EX30V4 DAE4 Secundary Standards Power meter EPM-442A Power meter EPM-442A Power sensor HP S481A Power sensor HP S481A AF generator R&E SMT-06 Network Analyzei Agilent FRS584	critical for celloration) ID # SN: 104776 SN: 103244 SN: 103245 SN: 5047.2 (9827) SN: 5047.2 (9827) SN: 5047.2 (9827) SN: 5047.2 (9837) SN: 601 ID # SN: 0537292783 SN: 4044 (082317) SN: 106972 SN: 10541080477 Nama	Cal Date (Certificate No.) 04-Apr-16 (No. 217-02672)(02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 06-Oct-17 (No. 202-7348_Dac-17) 26-Oct-17 (No. DAE+601_Oct-17) Check Date (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-14 (in house check Oct-17) Function	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Data-18 Data
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-281 Reterance 20 dB Atenustor Type-N mismatich combination Retatance Proba EX30V4 DAE4 Secundary Standards Power meter EPM-442A Power meter EPM-442A Power sensor HP S481A Power sensor HP S481A AF generator R&E SMT-06 Network Analyzei Agilent FRS584	critical for cellocation) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 7349 SN: 601 ID # SN: 0837490704 SN: 0837292783 SN: Mr44082317 SN: 10541080477	Cal Date (CentRote No.) 04-Apr-16 (No. 217-02872/02873) 04-Apr-18 (No. 217-02872) 04-Apr-18 (No. 217-02872) 04-Apr-18 (No. 217-02802) 04-Apr-18 (No. 217-02802) 04-Apr-18 (No. 217-02883) 30-Dac-17 (No. EX3-7349_Dec-17) 26-Oct-17 (No. DAE+601_Oct17) Check Date (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-17)	Scheduled Calibration Apr-19 Apr-19 Apr-18 Apr-18 Data
	critical for celloration) ID # SN: 104776 SN: 103244 SN: 103245 SN: 5047.2 (9827) SN: 5047.2 (9827) SN: 5047.2 (9827) SN: 5047.2 (9837) SN: 601 ID # SN: 0537292783 SN: 4044 (082317) SN: 106972 SN: 10541080477 Nama	Cal Date (Certificate No.) 04-Apr-16 (No. 217-02672)(02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 30-Dac-17 (No. 217-02683) 06-Oct-17 (No. 202-7348_Dac-17) 26-Oct-17 (No. DAE+601_Oct-17) Check Date (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-14 (in house check Oct-17) Function	Scheduled Calibration Apr-19 Apr-19 Apr-18 Apr-18 Data
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Attenustor Type-N nieuratich combination Retainince Probe EX3DV4 DAE4 Secundary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A Ref generator RAS SMT-06 Network Analyzer Aglient ER3584 Calibrated by:	critical for ostionation) ID # SN: 104778 SN: 102245 SN: 3058 (20k) SN: 5047 2 / 06327 SN: 5047 2 / 06327 SN: 7349 SN: 601 ID # SN: 6037480704 SN: US37292783 SN: Mr41092317 SN: 106972 SN: US41080477 Nama Michael Weber	Cal Daté (Centificate No.) 04-Apr-18 (No. 217-02072/02073) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02683) 30-Dac-17 (No. EX3-7349_Dac-17) 26-Oct-17 (No. DAE+601_Oct17) Of-Oct-15 (In house check Oct-16) 07-Oct-15 (In house check Oct-16) 07-Oct-15 (In house check Oct-16) 07-Oct-15 (In house check Oct-16) 15-Jan-15 (In house check Oct-16) 15-Jan-15 (In house check Oct-16) 31-Mar-14 (In house check Oct-16) Date-140 (In house check Oct-16) 31-Mar-14 (In house check Oct-16)	Schedured Calibration Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Dec-18 Dec-18 Dec-18 Dec-16 Schedured Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18

Certificate No: D835V2-4d063_Aug18

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



Schweizerischer Kalitmierdiens Service suisse d'Malonnage Servizio svizzero di Ipratiua Swies Calibration Service

Accreditation No.: SCS 0108

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Glossary: TS

Co N/

3L	fissue simulating liquid
DONVE	sensitivity in TSL / NORM x,y,z
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 reh 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. 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%

Gertificate No: DB35V2-4d063 Aug18

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Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantóm	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz, = 5 mm	
Frequency	835 MHz = 1 MHz	

Head TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	martin 06.0
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.7 ± 6 %	0.92 mho/m ± 8 %
Head TSL temperature change during test	< 0.5 °C	_	1000

SAR result with Head TSL

SAR averaged over 1 cm ¹ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.48 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ² (10 g) of Head TSL	condition	
SAR averaged over 10 cm ² (10 g) of Head TSL SAR measured	condition 250 mW input power	1.55 W/kg

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	65.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.9±6%	0.99 mho/m ±6 %
Body TSL temperature change during test	< 0.5 °C		1

SAR result with Body TSL

SAR averaged over 1 cm ⁰ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.56 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 250 mW input power	1.59 W/kg:

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Projudance, transformed to feed point	51.3 Ω - 1.8 JΩ	
Return Loss	- 33.3 dB	

Antenna Parameters with Body TSL

impedance, transformed to feed point	47.7 Ω – 4.4 jΩ
Return Loss	- 25,8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.393 ns

After long term use with 100W radiated power, only a slight warming of the cipole 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-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 dioole 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
Menufactured on	November 27, 2006

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DASY5 Validation Report for Head TSL

Date: 22.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

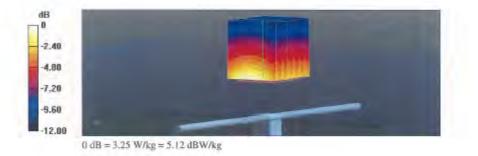
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.92$ S/m; $z_c = 40.7$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.9, 9.9, 9.9) @ 835 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- · Electronics: DAE4 Sn601; Calibrated: 26.10,2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 62.96 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.70 W/kg SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.55 W/kg Maximum value of SAR (measured) = 3.25 W/kg



Certificate No: D835V2-4d063_Aug18

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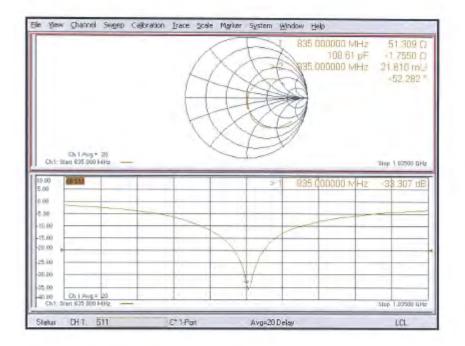
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Impedance Measurement Plot for Head TSL



Certificate No: D635V2-4d063_Aug18

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DASY5 Validation Report for Body TSL

Date: 23.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

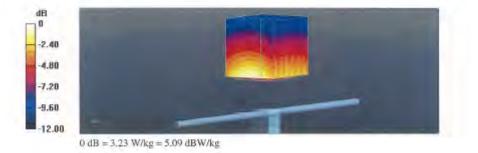
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d063

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; o = 0.99 S/m; a = 54.9; p = 1000 kg/m⁴ Phantom section: Flat Section Measurement Standard: DASY5 (JEEE/JEC/ANSI C63 19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.05, 10.05, 10.05) @ 835 MHz; Calibrated: 30.12.2017 .
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 60.67 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.61 W/kg SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.59 W/kg Maximum value of SAR (measured) = 3.23 W/kg



Certificate No: D635V2-4d063_Aug18

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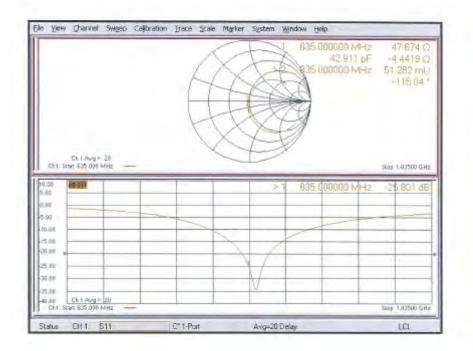
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Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d063_Aug18

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Certificate No: D1750V2-1008_Aug18

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No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803/新北市五股區新北產業園區五工路 134號 SGS Taiwan Ltd. t (886-2) 2299-3279

f (886-2) 2298-0488



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



Schweizerischer Kalibrierdienwi Service suissa d'étalonnege Servizio svizzero di teratura Swiss Calibration Service

Accreditation No.: SCS 0108

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Activatized by the Swias Accreditation Service (SAS)

The Swise Accred	Idation Service in one of the signatories to the EA
Multilateral Agree	ment for the recognition of calibration certificaties
Glossary:	
TSI	tiesus elmulating liquid

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
- of the certificate. All figures stated in the certificate are valid at the frequency indicated. Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented
- parallel to the body axis. Feed Point Impedance and Return Loss: These parameters are measured with the dipole
- positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna 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 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: D17E0V2-1008_Aug18

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Measurement Conditions

DASY system configuration, as far as not given on page

DASY Version	DASYS	V52,10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Fiad Phantom	
Distance Dipole Center - TSL	10 mm	with Spaper
Zoom Scan Resolution	dx, dy, dz; = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mbolm
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.34 mba/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		1000

SAR result with Head TSL

SAR averaged over 1 cm ¹ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	35.5 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL.	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL. SAR measured	condition 250 mW input power	4.61 W/kg

Body TSL parameters

The following parameters and calculations were applied.

	Temperatura	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mino/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.4 ± 0 %	1.47 mho/m = 6 %
Body TSL temperature change during test	< 0.5 °C	-	-

SAR result with Body TSL

SAR averaged over 1 cm ² (1 g) of Body TSL	Condition	
SAR meesured	250 mW input power	9.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.0 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ² (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.93 W/kg

Certificate No: D1750V2-1006_Aug/18

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0 Ω + 1.6 jΩ
Ratum Loss	= 32.2 mH

Antenna Parameters with Body TSL

Impedance, transformed to feed point	ii6,3 Ω + 0.6 jΩ
Ratum Loss	- 34.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1:207 ns

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

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

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

Additional EUT Data

Manufactured by	SPEAG	
Manufactured on	February 11, 2009	

Certificate No. D1750V2-1008 Aug18

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DASY5 Validation Report for Head TSL

Date: 30.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

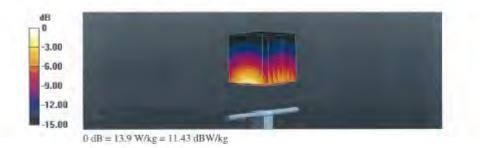
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; $\sigma = 1.34$ S/m; $\epsilon_r = 38.9$; p = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30,12,2017
- . Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017 .
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001 .
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439) .

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 = 107.6 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 16.3 W/kg SAR(1 g) = 9.07 W/kg; SAR(10 g) = 4.81 W/kg Maximum value of SAR (measured) = 13.9 W/kg



Certificate No: D1750V2-1008_Aug18

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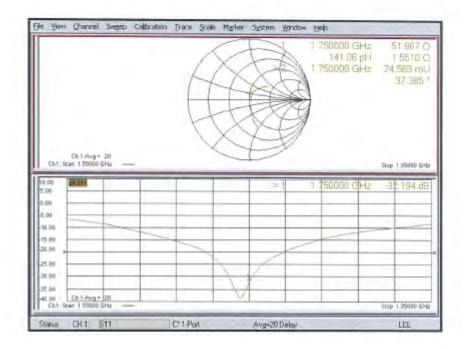
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Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1008_Aug18

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DASY5 Validation Report for Body TSL

Date: 30.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; $\sigma = 1.47 \text{ S/m}$; $\epsilon_c = 53.4$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) .
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002 .
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 101.7 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 15.9 W/kg SAR(1 g) = 9.16 W/kg; SAR(10 g) = 4.93 W/kg Maximum value of SAR (measured) = 13.7 W/kg



Certificate No: D1750V2-1008_Aug18

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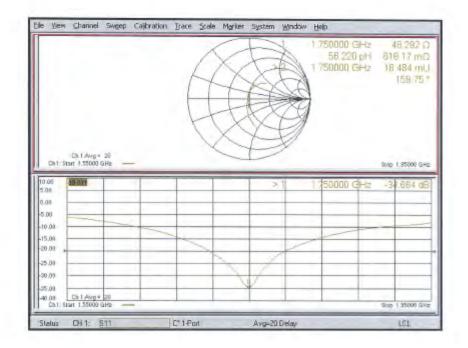
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Report No. : EN/2018/C0021 Rev: 01 Page: 25 of 72

Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1008_Aug18

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Silent SGS-TW (Aud			: D1900V2-5d173_Apr18
CALIBRATION	CERTIFICATI	E	
Object	D1900V2 - SN:5	d173	-
Colibration procedure(s)	QA CAL-05.v10 Calibration proce	edure for dipole validation kits ab	ove 700 MHz
Colibration date:	April 25, 2018		
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		Cal Parts (Contractor Mark	and the second second
Primery Standards	10.4	Cel Date (Certificate No.)	Schedule/) Calibration
Primary Standards Rover meter NRIP	ID 8 SN: 104776	04-Apr-18 (No. 217-02672/02673)	Apt-19
Primery Standards Power meter NRP Power sensor NRP-201	ID # SN: 104776 SN: 103244	D4-Apr-18 (No. 217-02672/02673) D4-Apr-18 (No. 217-02672)	Ap+19 Ap+10
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291	ID 8 SN: 104778 SN: 103244 SN: 103245	04-Apr-18 (No. 217-02572/02673) 04-Apr-18 (No. 217-02672) 04-Apr-16 (No. 217-02673)	Арн 19 Арн 19 Арн 19
Primery Standards Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Reference 20 dB Attenuator	ID # SN: 104776 SN: 103244	D4-Apr-18 (No. 217-02672/02673) D4-Apr-18 (No. 217-02672)	Ap+19 Ap+10
Calibration Equipment used (M8 Primary Standards Power meter NRP Power sensor NRP-201 Power sensor NRP-201 Patienes: 20 GE Attenuetor Type-N mestation combaration	ID 8 SN: 104778 SN: 103244 SN 103245 SN: 5058 (20k)	D4-Apr-18 (No. 217-02672/02673) D4-Apr-18 (No. 217-02672) D4-Apr-18 (No. 217-02672) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02582)	Арн-19 Арл-19 Арл-19 Арл-19
Primary Standards Power sensor NRP-201 Power sensor NRP-201 Peterance 20 GB Attenuacor Yon-Y missistich combinistion Telerance Probe EX2DV4	ID 8 SN: 104776 SN: 103244 SN: 103245 SN: 5087245 SN: 50872 / 06327	D4-Apr-18 (No. 217-02572/02673) D4-Apr-18 (No. 217-02572) D6-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02583) D4-Apr-18 (No. 217-02583)	Арн-19 Арн-19 Арн-19 Арн-19 Арн-19
Primary Standards Power sensor NRP-201 Power sensor NRP-201 Pelerance 20 dB Altenuesor Type-N mestsatch combanation Reference Probe EX3DV4 DAE4 Becondery Standards	1D 8 SN: 104775 SN: 103245 SN: 5068 (20k) SN: 5068 (20k) SN: 5087/2 / 06327 SN: 7349 SN: 601	D4-Apr-18 (No. 217-02572/02673) D4-Apr-18 (No. 217-02572) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02582) D4-Apr-18 (No. 217-02583) 30-Dic-17 (No. 525-7349, Dec17) 28-Dic-17 (No. DAE4-601_Oct17) Chieck Dale (In house)	Apr-19 Apr-10 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Oct-18 Scheduted Oteck
Primary Standards Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Reference 90 dB Attenuetor Type-N mismatch combanistion Type-N mismatch combanistion Dype-N mismatch EXIDV4 DAE4 Secondary Standards Power mater EPM-442A	ID 8 SN: 104775 SN: 103244 SN: 103245 SN: 5068 (20k) SN: 5068 (20k) SN: 5067 2 / 06327 SN: 7348 SN: 601 ID # SN: 6037480704	D4-Apr-18 (No. 217-02572)/02673) D4-Apr-18 (No. 217-02572) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02583) D4-Apr-18 (No. 217-02583) 30-Dac-17 (No. 525-7349, Dec17) 29-Dat-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Dec-18 Oci-18 Scheduted Check In house check. Oci-18
Primary Standards Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Alternator Pype-N misriatich combinistion Pype-N misriatich combinistion Pype-N misriatich combinistion Pipe-N misria	ID 8 SN: 104776 SN: 103244 SN: 103245 SN: 5068 (20k) SN: 50472 (06327 SN: 7348 SN: 601 ID # SN: 6537460704 SN: U537292763	D4-Apr-18 (No. 217-08572)/02673) D4-Apr-18 (No. 217-02572) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02583) D4-Apr-18 (No. 217-02583) 30-Dac-17 (No. 217-02583) 30-Dac-17 (No. 2053-7349, Dec17) 28-Dd-17 (No. DAE4-601_Oct17) Check Dain (In house) 07-Od-15 (In house check Od-16) 07-Od-15 (In house check Od-16)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18
Primary Standards Power sensor NRP-291 Power sensor NRP-291 Palerence 20 dB Attenuator Type-N missifiator operation Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 2481A Power sensor HP 2481A	1D 8 SN: 104776 SN: 103244 SN: 103245 SN: 5068 (20k) SN: 5068 (20k) SN: 5067 2 / 06927 SN: 7349 SN: 601 ID # SN: 6057480704 SN: 6557480704 SN: 6557282785 SN: MY41092317	D4-Apr-18 (No. 217-08572)/02673) D4-Apr-18 (No. 217-02572) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02582) D4-Apr-18 (No. 217-02583) 30-Dic-17 (No. 217-02583) 30-Dic-17 (No. 2NE4-601_Oct17) 28-Ost-17 (No. DAE4-601_Oct17) Check Dain (In house) D7-Oct-15 (in house check Oct-16) D7-Oct-15 (in house check Oct-16) D7-Oct-15 (in house check Oct-16)	Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-18 Dec-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Primary Standards Power sensor NRP-201 Power sensor NRP-201 Pelerance 20 dB Altenuskor Type-N mestatch combanetion Reierance Probe EX3DV4 DAE4 Secondary Standards Power sensor RP 5481A Power sensor RP 5481A PF genetator P&S SMT-00	ID 8 SN: 104776 SN: 103244 SN: 103245 SN: 5068 (20k) SN: 50472 (06327 SN: 7348 SN: 601 ID # SN: 6537460704 SN: U537292763	D4-Apr-18 (No. 217-08572)/02673) D4-Apr-18 (No. 217-02572) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02583) D4-Apr-18 (No. 217-02583) 30-Dac-17 (No. 217-02583) 30-Dac-17 (No. 2053-7349, Dec17) 28-Dd-17 (No. DAE4-601_Oct17) Check Dain (In house) 07-Od-15 (In house check Od-16) 07-Od-15 (In house check Od-16)	Ap+19 Ap+19 Ap+19 Ap+19 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Schedured Oteck. In house check. Oct-18 In house check. Oct-18
Primary Standards Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Reference 90 dB Attenuetor Type-N mismatch combanistion Type-N mismatch combanistion Dype-N mismatch EXIDV4 DAE4 Secondary Standards Power mater EPM-442A	ID 8 SN: 104775 SN: 103245 SN: 5068 (20k) SN: 5068 (20k) SN: 5067 2 / 06927 SN: 7349 SN: 601 ID # SN: GB37460704 SN: US37292763 SN: MY41092317 SN: 100972	D4-Apr-18 (No. 217-02572/02673) D4-Apr-16 (No. 217-02573) D4-Apr-16 (No. 217-02573) D4-Apr-16 (No. 217-02583) D4-Apr-18 (No. 217-02583) 30-Dic-17 (No. EX5-7344, Dec17) 28-Dic-17 (No. DAE4-601_Oc17) Chieck Dain (in house) 07-Oc1-15 (in house check Oc1-16) 07-Oc1-15 (in house check Oc1-16) 07-Oc1-15 (in house check Oc1-16) 15-Jun-15 (in house check Oc1-16)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Primary Standards Power sensor NRP-201 Power sensor NRP-201 Pelerance 20 dB Altenuskor Type-N mestatch combanetion Reierance Probe EX3DV4 DAE4 Secondary Standards Power sensor RP 5481A Power sensor RP 5481A PF genetator P&S SMT-00	ID 8 SN: 104775 SN: 103244 SN: 103245 SN: 5068 (20k) SN: 50472 (06927 SN: 7348 SN: 601 ID 8 SN: GB37460704 SN: US37292763 SN: MY41082317 SN: 100972 SN: US37290585	D4-Apr-18 (No. 217-08572)/02673) D4-Apr-18 (No. 217-02572) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02583) D4-Apr-18 (No. 217-02583) 30-Dac-17 (No. 5X5-7349, Dec17) 28-Dc1-17 (No. DAE4-601_Oct17) Check Dain (in house D7-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) D7-Oct-15 (in house check Oct-16) D7-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17)	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Dec-18 Dec-18 Dec-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Primary Standards Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Alternakor Type-N misintatch combinistion Reletionce Probe EX3DV4 DAE4 Secondery Standents Power motor EPM-442A Power sensor HP 8481A Power sensor HP 8481A	1D 8 SN: 104776 SN: 103244 SN: 103245 SN: 5068 (20k) SN: 5067 2 / 06927 SN: 5067 2 / 06927 SN: 7349 SN: 601 ID # SN: 6057460704 SN: US37290765 SN: MY41092317 SN: 100972 SN: US37290565 Name	D4-Apr-18 (No. 217-08572)/02673) D4-Apr-18 (No. 217-02572) D4-Apr-18 (No. 217-02573) D4-Apr-18 (No. 217-02583) D4-Apr-18 (No. 217-02583) 30-Dac-17 (No. 217-02583) 30-Dac-17 (No. 2X5-7349, Dec17) 28-Dd-17 (No. DAE4-601_0ct17) Check Dain (In house) D7-Od-15 (In house check Oct-16) 07-Od-15 (In house check Oct-16) D7-Od-15 (In house check Oct-16) 15-Jun-15 (In house check Oct-16) 18-Od-01 (In house check Oct-16) 18-Od-01 (In house check Oct-17) Function	Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Dec-18 Dec-18 Dec-18 Dec-18 Scheduled Check In house check: Oct-18 In house check: Oct-18

Certificate No: D1900V2-5d173_Apr16

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Accession No.: SCS 0108

Accredited by the Swiss Accorditation Service (SAS)

The Swiss Acceeditation Service is one of the signatorias to the EA Multilateral Agreement for the recognition of calibration certific

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its leed 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%

Camilcana No: D1900V2-5d173 Aprill

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Measurement Conditions

DASY system configuration, as far as not given on page

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Fist Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	cbx, dy', dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	411±8%	1.35 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.7 W/kg = 17.0 % (k=2)
SAR averaged over 10 cm ² (10 g) of Head TSL	opridition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	opridition 250 mW input power	5.21 W/kg

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.3 ± 6 %	1.47 mho/m±6 %
Body TSL temperature change during test	≈0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ² (1 g) of Body TSL	Contition	
SAR measured	250 mW input power	9.93 W/kg
SAR for nominal Body TSL parameters	W1 of besilemon	40.9 W/kg ± 17.0 % (k=2)
CAD averaged avera 10 cmd (10 c) of Body TCI	andta	
SAR averaged over 10 cm ² (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 250 mW input power	5.30 W/kg

Certificate No: D1900V2-5d173_April8

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.4 Q + 5 1 JQ
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed pully	47.341 + 7.2 10
Return Loss	- 22 1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1,195 ns

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

The clipple 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 erms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 08, 2012

Certificate No: D1900V2-5d173 Aprill

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Date: 25.04.2018

DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

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

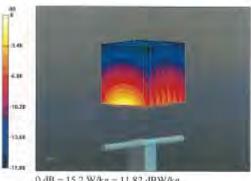
Communication System: UID 0 - CW: Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; $\sigma = 1.35$ S/m; $v_c = 41.1$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANS) C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.18, 8.18, 8.18); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 110.9 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 18.3 W/kg SAR(1 g) = 9.89 W/kg; SAR(10 g) = 5.21 W/kg Maximum value of SAR (measured) = 15.2 W/kg



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

Certificate No: D1900V2-5d173_Apr18

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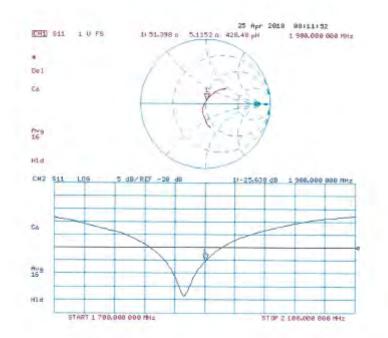
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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 25.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; $\sigma = 1.47$ S/m; $v_f = 55.3$; p = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.15, 8.15, 8.15); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) .
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.6 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 17.7 W/kg SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.3 W/kg Maximum value of SAR (measured) = 14.7 W/kg



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

Certificate No: D1900V2-5d173 Apr18

Page 7 of 8

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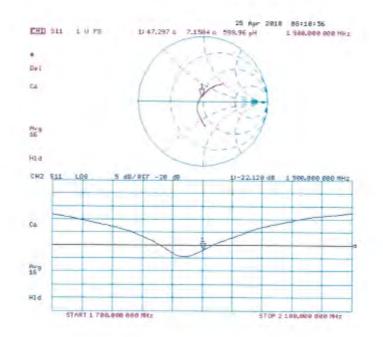
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Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d173_Apr18

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Accredited by the Swiss Accreditation The Swiss Accreditation Service Aultilateral Agreement for the re-	is one of the signatori	es to the EA	Accreditation No.: SCS 0108
CALIBRATION C		-	No: D2300V2-1023_Aug18
		-	
Object	D2300V2 - SN:1	023	
Calibration procedure(s)	QA CAL-05.v10 Calibration proce	edure for dipole validation kits at	oove 700 MHz
Calibration date:	August 24, 2018		
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Certificate No: D2300V2-1023_Aug18

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



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Accreditation No.: SCS 0108

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Multilateral Agreement for the recognition of calibration certificates Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantem	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2300 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.2 ± 6 %	1.70 mho/m ± 6 %
Head TSL temperature change during test	× 0.6 °C		

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.3 W/kg
SAR for norminal Head TSL parameters	with the second second	48.4 W/kg a 17.0 % (k=2)
SAR averaged over 10 cm ² (10 g) of Head TSL	condition	
SAR averaged over 10 cm ² (10 g) of Head TSL SAR measured	condition 250 mW input power	5.93 W/kg

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	62.9	1.81 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.85 mho/m ± 6 %
Body TSL temperature change during test	≤ 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	47.7 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ² (10 g) of Body TSL	condition	
SAR averaged over 10 cm ² (10 g) of Body TSL SAR measured	condition 250 mW input power	5.86 W/kg

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.5 Ω - 2.1 jΩ
Return Loss	-33.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point.	45.4 Ω - 0.9 μΩ
Return Loss	: 26.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.171 ns
----------------------------------	----------

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

The dipole is made of standard somittigid coaxial cable. The center conductor of the feeding line is directly connected to line second arm of the dipole. The antenna is therefore shon-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" 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 dipole arms, because they might band or the soldered connections near the feedpoint may be carnaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 30, 2009

Certificate No: D2300V2-1023_Aug18

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Date: 23.08.2018

DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

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

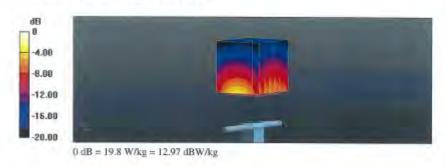
Communication System: UID 0 - CW; Frequency: 2300 MHz Medium parameters used: f = 2300 MHz; $\sigma = 1.7$ S/m; $\epsilon_r = 38.2$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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) ٠
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 114.4 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 23.7 W/kg SAR(1 g) = 12.3 W/kg; SAR(10 g) = 5.93 W/kg Maximum value of SAR (measured) = 19.8 W/kg



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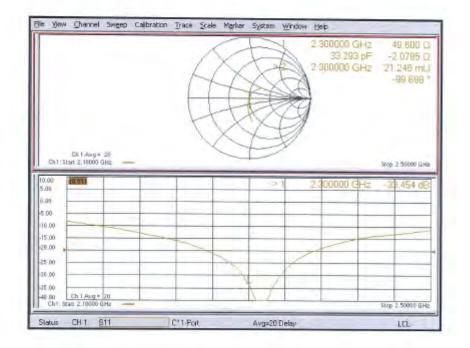
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Impedance Measurement Plot for Head TSL



Certificate No: D2300V2-1023_Aug18

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DASY5 Validation Report for Body TSL

Date: 24.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

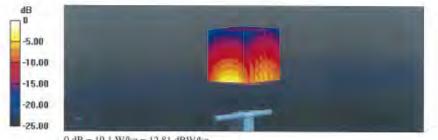
Communication System: UID 0 - CW; Frequency: 2300 MHz Medium parameters used: f = 2300 MHz; s = 1.85 S/m; e = 52.2; p = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA: Serial: 1002.
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 108.1 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 22.8 W/kg SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.86 W/kg Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

Certificate No: D2300V2-1023_Aug18

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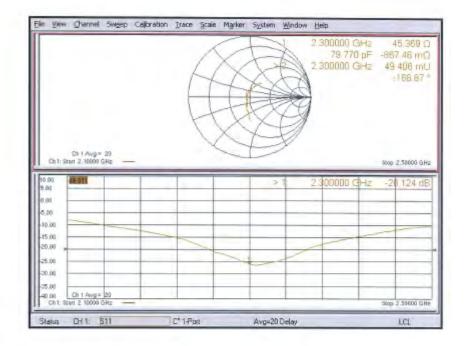
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Impedance Measurement Plot for Body TSL



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lient SGS-TW (Aude	n)	Certificate N	o: D2450V2-727_Apr18
CALIBRATION C	ERTIFICATE		
Dbject	D2450V2 - SN:72	27	
Calibration procedure(s)	QA CAL-05.v10	an an Anna an Anna an Anna an Anna an Anna an Anna	700 MIL-
	Calibration proce	dure for dipole validation kits ab	ove 700 MHz
Calibration date:	April 24, 2018		
		ional standards, which realize the physical u	
The measurements and the unce	rtainties with confidence p	robability are given on the following pages a	nd are part of the certificate.
All calibrations have been conduc	ted in the closed laborato	ry facility: environment temperature (22 ± 3)°	°C and humidity < 70%.
All calibrations have been conduc	cted in the closed laborato	ry facility: environment temperature $(22 \pm 3)^{\circ}$	°C and humidity < 70%.
		ry facility: environment temperature (22 \pm 3)*	°C and humidity < 70%.
		ry facility: environment temperature (22 \pm 3)	°C and humidity < 70%.
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Calibration Equipment used (M&* Primary Standards	TE critical for calibration)		
Calibration Equipment used (M& Primary Standards Power meter NRP	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91	TE critical for calibration)	Cal Date (Certilicate No.) 04-Apr-18 (No. 217-02672/02673)	Scheduled Celibration Apr-19
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	TE critical for calibration)	Cal Date (Certilicate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672)	Scheduled Celibration Apr-19 Apr-19
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	TE critical for calibration)	Cal Date (Certilicate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673)	Scheduled Celibration Apr-19 Apr-19 Apr-19
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	TE critical for calibration)	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682)	Scheduled Celibration Apr-19 Apr-19 Apr-19 Apr-19
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 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)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 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)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 7349 SN: 601	Cal Date (Certilicate No.) 04-Apr-18 (No. 217-02672/02673) 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) 26-Oct-17 (No. DAE4-601_Oct17)	Scheduled Celibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 7349 SN: 601 ID #	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 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) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	Scheduled Celibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 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) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 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) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Scheduled Celibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 601 ID # SN: 6837480704 SN: G837480704 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 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) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Scheduled Celibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reterence Probe EX30V4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 03-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 841A Power sensor HP 841A RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: WY41092317 SN: 100972 SN: US37390585 Name	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02683) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec-17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17) Function	Scheduled Celibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 03-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 841A Power sensor HP 841A RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: WY41092317 SN: 100972 SN: US37390585 Name	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02683) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec-17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17) Function	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8431A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: WY41092317 SN: 100972 SN: US37390585 Name	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672) 04-Apr-18 (No. 217-02673) 04-Apr-18 (No. 217-02683) 04-Apr-18 (No. 217-02683) 30-Dec-17 (No. EX3-7349_Dec-17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17) Function	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reterence Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Calibrated by:	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: 100972 SN: 100972 SN: 1037390585 Name Jeton Kastrati	Cal Date (Certilicate No.) 04-Apr-18 (No. 217-02672/02673) 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. 217-02683) 30-Dec-17 (No. 217-02683) 30-Dec-17 (No. DAE4-601_Oct17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reterence Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Calibrated by:	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: 100972 SN: 100972 SN: 1037390585 Name Jeton Kastrati	Cal Date (Certilicate No.) 04-Apr-18 (No. 217-02672/02673) 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. 217-02683) 30-Dec-17 (No. 217-02683) 30-Dec-17 (No. DAE4-601_Oct17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18

Certificate No: D2450V2-727_Apr18

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Schweizerischer Kalibrierdienst S Service suisse d'étalonnage С Servizio svizzero di taratura S

Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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f (886-2) 2298-0488



Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.3 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	6.16 W/kg

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	52.5 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.8 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 250 mW input power	6.00 W/kg

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.2 Ω + 2.7 jΩ	
Return Loss	- 25.1 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.2 Ω + 5.6 jΩ	
Return Loss	- 25.0 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns	
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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	January 09, 2003

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DASY5 Validation Report for Head TSL

Date: 24.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = 1.86 \text{ S/m}$; $\varepsilon_r = 38.3$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.88, 7.88, 7.88); Calibrated: 30.12.2017.
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) .
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017 .
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001 *
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417) •

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 116.0 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 26.7 W/kg SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.16 W/kg Maximum value of SAR (measured) = 22.0 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg

Certificate No: D2450V2-727_Apr18

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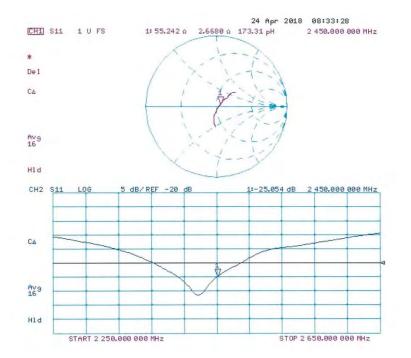
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Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-727_Apr18

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DASY5 Validation Report for Body TSL

Date: 24.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = 2.01 \text{ S/m}$; $\varepsilon_r = 52.5$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.01, 8.01, 8.01); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017 .
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002 ٠
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 108.4 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 25.5 W/kg SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6 W/kg Maximum value of SAR (measured) = 21.1 W/kg



0 dB = 21.1 W/kg = 13.24 dBW/kg

Certificate No: D2450V2-727_Apr18

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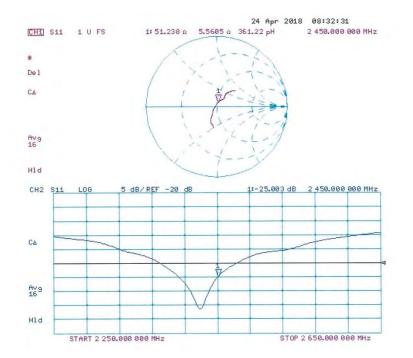
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Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-727_Apr18

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Accredited by the Swiss Accredit The Swiss Accreditation Servic Multilateral Agreement for the r	e is one of the signatorie	es to the EA	Accreditation No.: SCS 0108
Client Auden			No: D2600V2-1058_Jun18
CALIBRATION C	ERTIFICATI		
Object	D2600V2 - SN:1	058	
Calibration procedure(s)	QA CAL-05.v10 Calibration proce	edure for dipole validation kits ab	ove 700 MHz
Calibration date:	June 19, 2018		
	cted in the closed laborato	ry facility: environment temperature (22 \pm 3)	
All calibrations have been conduct	cted in the closed laborato		°C and humidity < 70%.
All calibrations have been condu Calibration Equipment used (M& Primary Standards	cted in the closed laborato	ry facility: environment temperature (22 \pm 3)	
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All calibrations have been condu Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	tted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID #	Cal Date (Certificate No.) 04-Apr-18 (No. 217-02672/02673) 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) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	°C and humidity < 70%. Scheduled Calibration Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Apr-19 Dec-18
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Certificate No: D2600V2-1058_Jun18

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





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

Accreditation No.: SCS 0108

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

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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless C) communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.4 ± 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	14.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.8 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	6.38 W/kg

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.8 ± 6 %	2.22 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	54.4 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 250 mW input power	6.15 W/kg

Certificate No: D2600V2-1058 Jun18

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.7 Ω - 7.5 jΩ
Return Loss	- 22.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.3 Ω - 6.9 jΩ
Return Loss	- 21.1 dB

General Antenna Parameters and Design

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

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 14, 2012

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DASY5 Validation Report for Head TSL

Date: 19.06.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

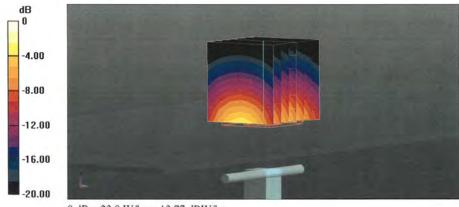
Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.03 \text{ S/m}$; $\varepsilon_r = 37.4$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.7, 7.7, 7.7) @ 2600 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017 .
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA: Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 117.8 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 28.5 W/kg SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.38 W/kg Maximum value of SAR (measured) = 23.8 W/kg



0 dB = 23.8 W/kg = 13.77 dBW/kg

Certificate No: D2600V2-1058_Jun18

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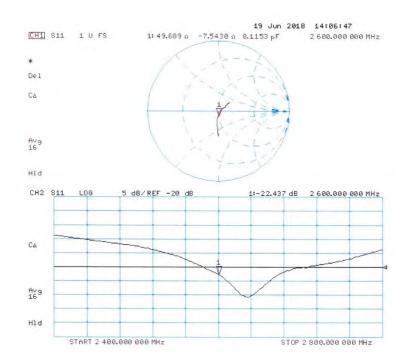
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Report No. : EN/2018/C0021 Rev: 01 Page: 55 of 72

Impedance Measurement Plot for Head TSL



Certificate No: D2600V2-1058_Jun18

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DASY5 Validation Report for Body TSL

Date: 19.06.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

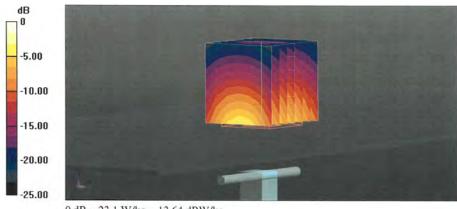
Communication System: UID 0 - CW; Frequency; 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.22 \text{ S/m}$; $\epsilon_r = 51.8$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.81, 7.81, 7.81) @ 2600 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 107.8 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 28.0 W/kg SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.15 W/kg Maximum value of SAR (measured) = 23.1 W/kg



0 dB = 23.1 W/kg = 13.64 dBW/kg

Certificate No: D2600V2-1058_Jun18

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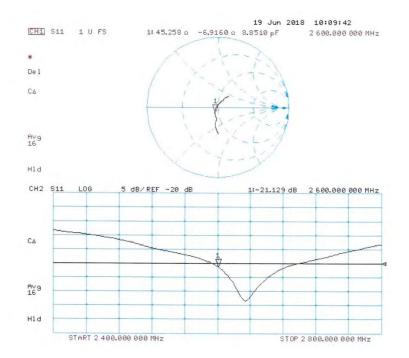
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Report No. : EN/2018/C0021 Rev: 01 Page: 57 of 72

Impedance Measurement Plot for Body TSL



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ient SGS-TW (Aude	en)	Certificate No	D5GHzV2-1023_Jan18
ALIBRATION	CERTIFICATE		
Dbject	D5GHzV2 - SN:1	023	
Calibration procedure(s)	QA CAL-22.v2 Calibration proce	dure for dipole validation kits bet	ween 3-6 GHz
Calibration date:	January 25, 2018	3	
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Swiss Calibration Service

Accreditation No.: SCS 0108

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	4.50 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	7.72 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.3 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 100 mW input power	2.22 W/kg

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Head TSL parameters at 5300 MHz

	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	36.2 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	تبت	

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.9 W / kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 100 mW input power	2.32 W/kg

Head TSL parameters at 5600 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	4.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5800 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.11 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 ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.0 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 100 mW input power	2.25 W/kg

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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	47.3 ± 6 %	5.41 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	70.9 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 100 mW input power	2.00 W/kg

Body TSL parameters at 5300 MHz

	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	47.1 ± 6 %	5.54 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

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SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	a second
SAR measured	100 mW input power	7.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.4 W/kg ± 19.5 % (k=2)

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Body TSL parameters at 5600 MHz

	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	46.6 ± 6 %	5.94 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	7.81 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.6 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 100 mW input power	2.19 W/kg

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	46.2 ± 6 %	6.22 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 ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 19.5 % (k=2)

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	50.1 Ω - 8.1 jΩ	
Return Loss	- 21.9 dB	

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	50.5 Ω - 2.3 jΩ	
Return Loss	- 32.7 dB	

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω - 0.7 jΩ	1.1.1.
Return Loss	- 28.4 dB	

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.3 Ω + 2.6 jΩ	
Return Loss	- 25.1 dB	

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.8 Ω - 6.9 jΩ
Impedance, transformed to reed point	
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	50.9 Ω - 0.9 jΩ	
Return Loss	- 37.9 dB	

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	56.0 Ω + 0.5 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.6 Ω + 2.3 jΩ	_
Return Loss	- 23.7 dB	

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General Antenna Parameters and Design

Electrical Delay (one direction)	1,199 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	February 05, 2004

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DASY5 Validation Report for Head TSL

Date: 25.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 4.5 \text{ S/m}$; $\epsilon_r = 36.3$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: f = 5300 MHz; σ = 4.6 S/m; ϵ_r = 36.2; ρ = 1000 kg/m³, Medium parameters used: f = 5600 MHz; $\sigma = 4.9 \text{ S/m}$; $\varepsilon_r = 35.8$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5800 MHz; $\sigma = 5.11 \text{ S/m}$; $\varepsilon_r = 35.5$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.75, 5.75, 5.75); Calibrated: 30.12.2017, ConvF(5.5, 5.5, 5.5); Calibrated: 30.12.2017, ConvF(5.05, 5.05, 5.05); Calibrated: 30.12.2017, ConvF(4.96, 4.96, 4.96); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=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 = 70.47 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 27.5 W/kg SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.22 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 = 74.63 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 29.6 W/kg SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.32 W/kg Maximum value of SAR (measured) = 18.6 W/kg

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 = 70.79 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 31.5 W/kg SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.34 W/kg Maximum value of SAR (measured) = 19.6 W/kg

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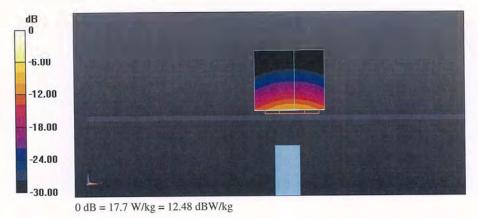
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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.22 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 31.2 W/kg SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.25 W/kg Maximum value of SAR (measured) = 19.0 W/kg



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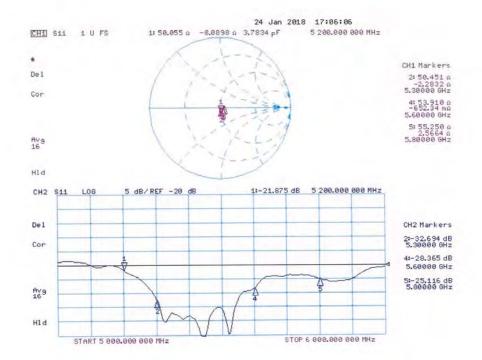
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 23.01.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz Medium parameters used: f=5200 MHz; $\sigma=5.41$ S/m; $\epsilon_r=47.3;\,\rho=1000$ kg/m^3 , Medium parameters used: f = 5300 MHz; $\sigma = 5.54 \text{ S/m}$; $\epsilon_r = 47.1$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: f = 5600 MHz; $\sigma = 5.94 \text{ S/m}$; $\varepsilon_r = 46.6$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5800 MHz; $\sigma = 6.22 \text{ S/m}$; $\varepsilon_r = 46.2$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.35, 5.35, 5.35); Calibrated: 30.12.2017, ConvF(5.15, 5.15, 5.15); Calibrated: 30.12.2017, ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2017, ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=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 = 66.00 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 26.4 W/kg SAR(1 g) = 7.14 W/kg; SAR(10 g) = 2 W/kg Maximum value of SAR (measured) = 16.8 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 = 65.19 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 28.4 W/kg SAR(1 g) = 7.34 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=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 66.21 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 32.8 W/kg SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.19 W/kg Maximum value of SAR (measured) = 19.1 W/kg

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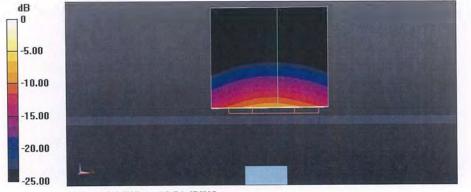
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Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.05 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 32.3 W/kg SAR(1 g) = 7.46 W/kg; SAR(10 g) = 2.07 W/kg Maximum value of SAR (measured) = 18.8 W/kg



0 dB = 18.8 W/kg = 12.74 dBW/kg

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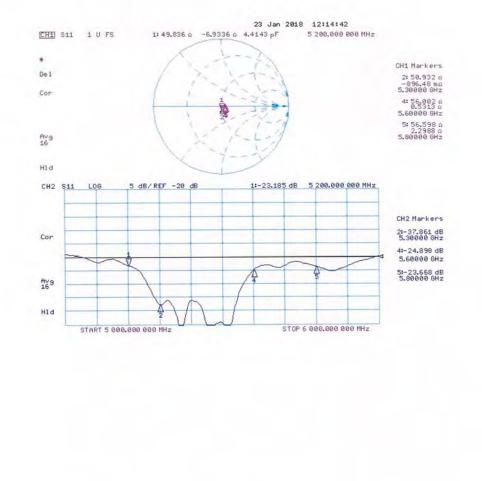
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Impedance Measurement Plot for Body TSL

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