1.1. D835V2 Dipole Calibration Certificate

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redited by the Swiss Accreditatio	in Service (SAS)		editation No.: SCS 0108
Curles Accorditation Service	s one of the signatories t	o the EA	
tilateral Agreement for the rec	ognition of calibration ce	Hundenes	D835V2-4d238_Feb18
ont CCIC-HTW (Aud	en)	Certificate No: 1	083572-40250_1 0810
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ALIBRATION C	ERTIFICATE		
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CONTRACTOR NO. OF CONTRACTOR OF CONTRACTOR	QA CAL-05.V9		An and a state of the state of the
alibration procedure(s)	Calibration proced	ture for dipole validation kits abov	e 700 MHz
	Gailbration process		
alibration date:	February 19, 2018	В	
Billion and a street	and the second se		
		y facility; environment temperature $(22 \pm 3)^{\circ}C$	and humidity < 70%.
		y facility; environment temperature (22 ± 3)°C	
calibration Equipment used (M&		Cal Date (Certificate No.)	Scheduled Calibration
alibration Equipment used (M&	TE critical for calibration)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration Apr-18
alibration Equipment used (M& rimary Standards rower meter NRP	TE critical for calibration) ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	Scheduled Calibration
alibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	Scheduled Calibration Apr-18 Apr-18
alibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	Scheduled Calibration Apr-18 Apr-18 Apr-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	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-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: 7349	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
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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)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02622) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check
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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 C Servizio svizzero di taratura

s Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D835V2-4d238_Feb18

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Measurement Conditions

n as far as not given on page 1. D

ASY system configuration, as far as noty	DASY5	V52.10.0
DASY Version		
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
	835 MHz ± 1 MHz	
Frequency		

Head TSL parameters

e following parameters and calculations were appli	Temperature	Permittivity	Conductivity
	22.0 °C	41.5	0.90 mho/m
Nominal Head TSL parameters	(22.0 ± 0.2) °C	41.2 ± 6 %	0.92 mho/m ± 6 %
Measured Head TSL parameters	< 0.5 °C		0.2222
Head TSL temperature change during test	< 0.5 0	1000	

3. 3

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
	250 mW input power	2,42 W/kg
SAR measured	normalized to 1W	9.51 W/kg ± 17.0 % (k=2)
SAR for nominal Head TSL parameters	Horntaine of A	
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
	250 mW input power	1.56 W/kg
SAR measured	normalized to 1W	6.15 W/kg ± 16.5 % (k=2)
SAR for nominal Head TSL parameters		

Body TSL parameters

	and	colculations were applied.	
The following	parameters and	calculations were applied.	

e following parameters and calculations were apply	Temperature	Permittivity	Conductivity
	22.0 °C	55.2	0.97 mho/m
Nominal Body TSL parameters	(22.0 ± 0.2) °C	55.0 ± 6 %	0.99 mho/m ± 6 %
Measured Body TSL parameters	< 0.5 °C		
Body TSL temperature change during test	20.0 0		

SAR result with Body TSL

wer 2.45 W/kg
W 9.64 W/kg ± 17.0 % (k=2)
ower 1.60 W/kg
W 6.32 W/kg ± 16.5 % (k=2
1

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6 Ω - 6.0 jΩ
Impedance, transionned to teed point	- 23.6 dB
Return Loss	- 25.0 00

General Antenna Parameters and Design

	1.391 ns
Electrical Delay (one direction)	

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

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

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

Additional EUT Data

For a second	SPEAG
Manufactured by	June 02, 2017
Manufactured on	3018 02, 2017

Certificate No: D835V2-4d238_Feb18

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DASY5 Validation Report for Head TSL

Date: 19.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d238

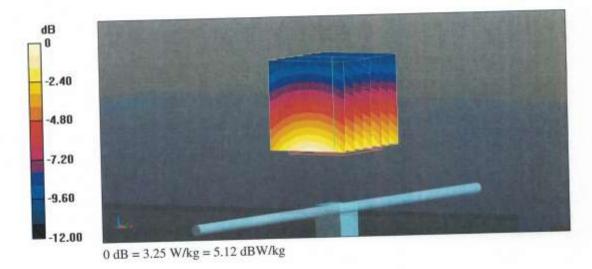
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ϵ_r = 41.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.9, 9.9, 9.9); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

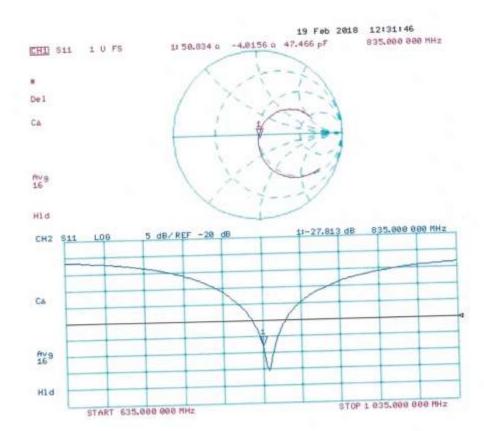
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 62.44 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.69 W/kg SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.56 W/kg Maximum value of SAR (measured) = 3.25 W/kg



Certificate No: D835V2-4d238_Feb18

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Impedance Measurement Plot for Head TSL

Certificate No: D835V2-4d238_Feb18

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DASY5 Validation Report for Body TSL

Date: 19.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d238

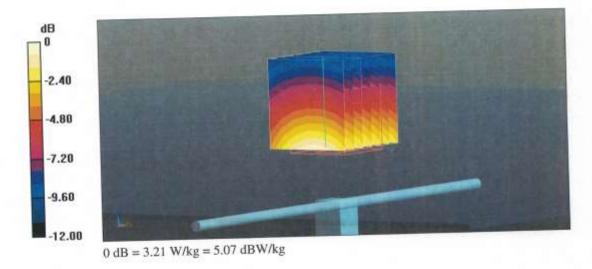
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.99 S/m; ϵ_r = 55; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.05, 10.05, 10.05); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

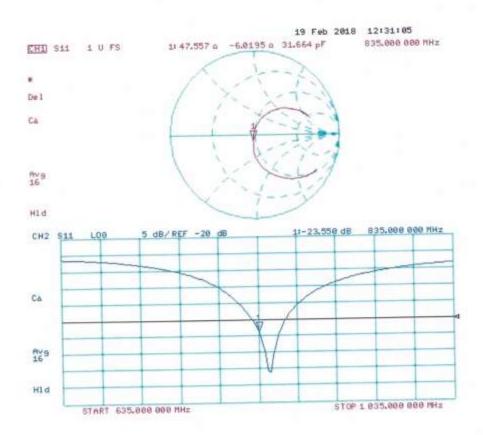
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 60.24 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.70 W/kg SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.6 W/kg Maximum value of SAR (measured) = 3.21 W/kg



Certificate No: D835V2-4d238_Feb18

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Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d238_Feb18

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1.2. D1750V2 Dipole Calibration Certificate

credited by the Swiss Accreditat e Swiss Accreditation Service Itilateral Agreement for the re	is one of the signatories	s to the EA	ccreditation No.: SCS 0108
ent CCIC-HTW (Au	den)	Certificate N	lo: D1750V2-1164_Feb18
ALIBRATION C	ERTIFICATE	Carling in succession	San Seven Disting
bject	D1750V2 - SN:11	64	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits ab	oove 700 MHz
Calibration date:	February 06, 201	8	
All calibrations have been conduc	cted in the closed laborato	robability are given on the following pages i ry facility: environment temperature (22 \pm 3)	
Il calibrations have been conduc Calibration Equipment used (M&	cted in the closed laborato	ry facility: environment temperature (22 ± 3) Cal Date (Certificate No.)	°C and humidity < 70%. Scheduled Calibration
All calibrations have been conduc Calibration Equipment used (M&) Primary Standards	ted in the closed laborato TE critical for calibration) ID # SN: 104778	ry facility: environment temperature (22 ± 3) Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	°C and humidity < 70%. Scheduled Calibration Apr-18
ul calibrations have been conduc calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	°C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18
Il calibrations have been conduc calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	End in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	°C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	Eted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	°C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	Eted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	ry facility: environment temperature (22 ± 3) Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	Eted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. EX3-7349_Dec17)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	ry facility: environment temperature (22 ± 3) Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-17 (No. 2X3-7349_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)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: 6B37480704 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) 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)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 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 In house check: Oct-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: 601 SN: 601 ID # SN: GB37480704 SN: U\$37292783 SN: MY41092317 SN: 100972 SN: 100972	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: 6B37480704 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) 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)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 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 In house check: Oct-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: 100972 SN: US37390585 Name	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-17) Function	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID # ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # SN: 6037480704 SN: US37292783 SN: 100972 SN: US37390585	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17)	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
	ted in the closed laborato TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: 100972 SN: US37390585 Name	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-17) Function	*C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18

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

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D1750V2-1164_Feb18

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S Schweizerischer Kalibrierdienst

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

Accreditation No.: SCS 0108

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.4 ± 6 %	1.35 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.6 W/kg ± 17.0 % (k≃2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	4.83 W/kg

Body TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.5 ± 6 %	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	****	

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.7 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured	condition 250 mW input power	4.84 W/kg

Certificate No: D1750V2-1164_Feb18

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω - 0.1 jΩ	
Return Loss	- 39.2 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω - 1.3 jΩ	
Return Loss	- 27.6 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.216 ns

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

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

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

Additional EUT Data

Manufactured by	SPEAG	
Manufactured on	March 07, 2016	

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DASY5 Validation Report for Head TSL

Date: 06.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

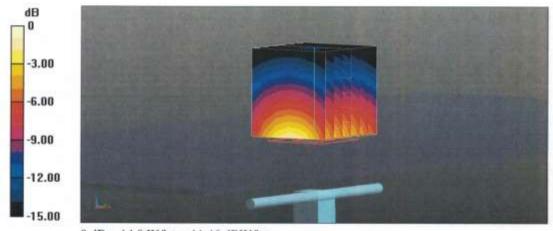
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; $\sigma = 1.35$ S/m; $\varepsilon_r = 39.4$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 106.4 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 16.8 W/kg SAR(1 g) = 9.11 W/kg; SAR(10 g) = 4.83 W/kg

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

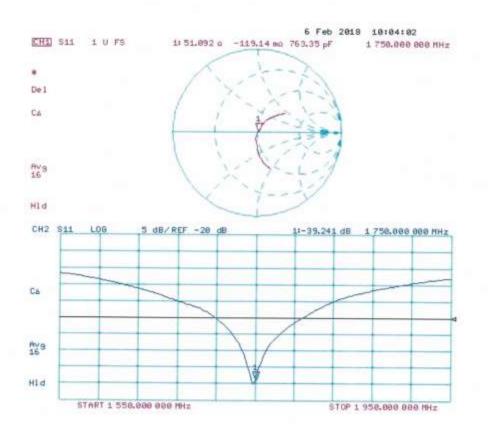


0 dB = 14.0 W/kg = 11.46 dBW/kg

Certificate No: D1750V2-1164_Feb18

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Certificate No: D1750V2-1164_Feb18

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DASY5 Validation Report for Body TSL

Date: 06.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

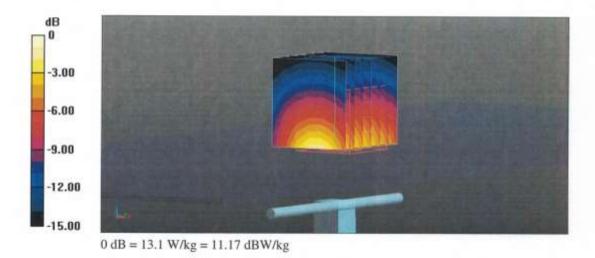
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1164

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

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.35, 8.35, 8.35); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

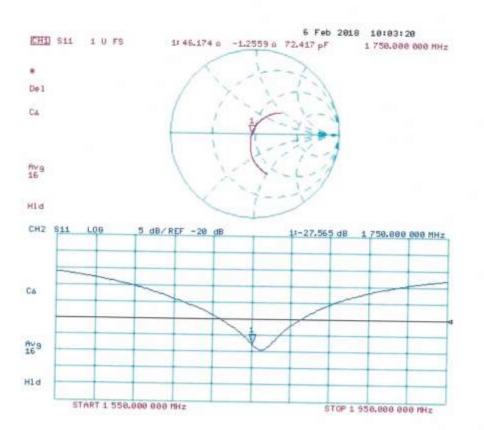
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 99.62 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 16.0 W/kg SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.84 W/kg Maximum value of SAR (measured) = 13.1 W/kg



Certificate No: D1750V2-1164_Feb18

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Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1164_Feb18

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1.3. D1900V2 Dipole Calibration Certificate

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zuri	ry of		S Schweizerischer Kalibrierdienst Service sulsse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accredit The Swiss Accreditation Servic Multilateral Agreement for the	e is one of the signator	ies to the EA	Accreditation No.: SCS 0108
Client CCIC-HTW (Au	uden)	Certificate I	No: D1900V2-5d226_Feb18
CALIBRATION	CERTIFICAT	E	
Object	D1900V2 - SN:5	5d226	and the second
Calibration procedure(s)	QA CAL-05.v9 Calibration proc	edure for dipole validation kits ab	ove 700 MHz
Calibration date:	February 22, 20	18	AND IN THE REAL OF
Calibration Equipment used (M&	TE critical for calibration)	Cal Date (Certificate No.)	
Calibration Equipment used (M&)	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
alibration Equipment used (M& rimary Standards lower meter NRP	TE critical for calibration)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration Apr-18
alibration Equipment used (M& rimary Standards lower meter NRP lower sensor NRP-Z91	TE critical for calibration)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	Scheduled Calibration Apr-18 Apr-18
alibration Equipment used (M& rimary Standards 'ower meter NRP 'ower sensor NRP-Z91 'ower sensor NRP-Z91	TE critical for calibration) ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18
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) ID # SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
Calibration Equipment used (M&) Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Spe-N mismatch combination	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18
alibration Equipment used (M& rimary Standards 'ower meter NRP 'ower sensor NRP-Z91 'ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference 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-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Neference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 NAE4 econdary Standards	TE critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID #	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Neference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 VAE4 econdary Standards ower meter EPM-442A	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 # SN: GB37480704	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. EX3-7349_Dec17) 26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Neference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 (AE4 econdary Standards ower meter EPM-442A ower sensor HP 8481A	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 # SN: 6B37480704 SN: US37292783	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 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)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination teleference Probe EX3DV4 (AE4 econdary Standards ower meter EPM-442A ower sensor HP 8481A ower 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 SN: MY41092317	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02522) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 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)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M&) Primary Standards Power meter NRP Power sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination teference Probe EX3DV4 AE4 econdary Standards ower meter EPM-442A ower sensor HP 8481A F 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: WY41092317 SN: 100972	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-17 (No. 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) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 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 ype-N mismatch combination telerence Probe EX3DV4 IAE4 econdary Standards ower meter EPM-442A ower sensor HP 8481A ower sensor HP 8481A F 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: WY41092317 SN: 100972 SN: US37390585	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02522) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 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)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 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 Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference R&S SMT-06 letwork Analyzer HP 8753E	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: WY41092317 SN: 100972 SN: US37390585 Name	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-19 (No. 217-02529) 30-Dec-19 (No.	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
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 Reference R&S SMT-06 Network Analyzer HP 8753E	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: WY41092317 SN: 100972 SN: US37390585	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-17 (No. 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) 18-Oct-01 (in house check Oct-17)	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Salibrated by:	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: WY41092317 SN: 100972 SN: US37390585 Name	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 217-02529) 30-Dec-19 (No. 217-02529) 30-Dec-19 (No.	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
All calibrations have been condu Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-291 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 Power sensor HP 8481A Regenerator 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: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: WY41092317 SN: US37390585 Name Michael Waber	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 30-Dec-17 (No. 2X3-7349_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) 15-Jun-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-17) Function Laboratory Technician	Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18

Certificate No: D1900V2-5d226_Feb18

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





S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage

Servizio svizzero di taratura Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D1900V2-5d226_Feb18

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Accreditation No.: SCS 0108

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.7 ± 6 %	1.39 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	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.3 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	5.25 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	55.2 ± 6 %	1.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.71 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.8 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	5.16 W/kg

Certificate No: D1900V2-5d226_Feb18

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 Ω + 6.0 jΩ
Return Loss	
	- 24.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.9 Ω + 7.5 ΙΩ
Return Loss	47.0 12 + 7.0 112
	- 22.0 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 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 be 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		
Manufactured by	SPEAG	
Manufactured on		
manafactured on	April 16, 2015	

Certificate No: D1900V2-5d226_Feb18

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DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

Date: 22.02.2018

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d226

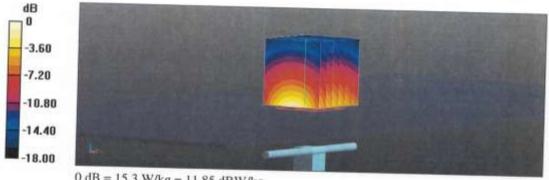
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.39 S/m; ϵ_c = 40.7; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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 ٠
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

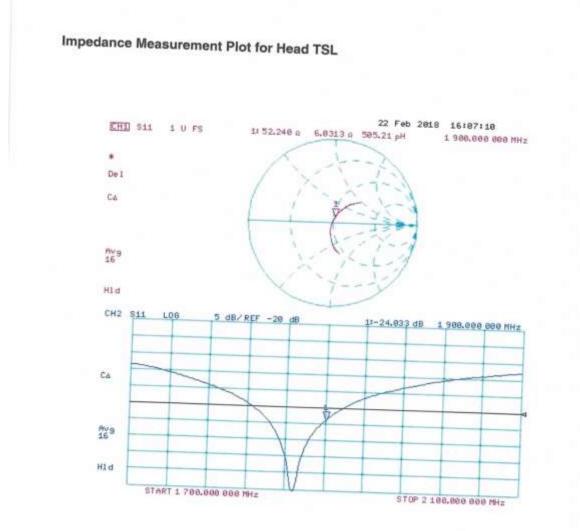
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 109.6 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 18.5 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.25 W/kg

Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

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Certificate No: D1900V2-5d226_Feb18

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Date: 22.02.2018

DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d226

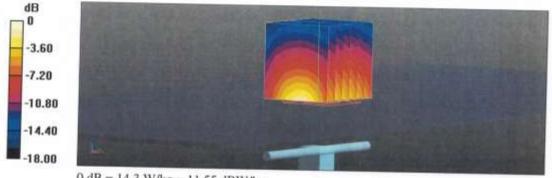
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.48 S/m; ϵ_r = 55.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(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 = 102.8 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 17.2 W/kg SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.16 W/kg Maximum value of SAR (measured) = 14.3 W/kg

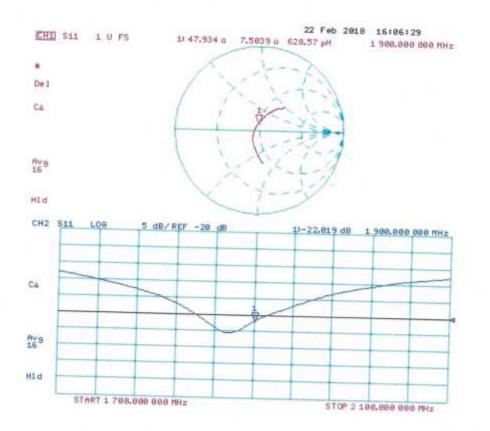


0 dB = 14.3 W/kg = 11.55 dBW/kg

Certificate No: D1900V2-5d226_Feb18

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Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d226_Feb18

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1.4. D2450V2 Dipole Calibration Certificate

Engineering AG Zeughausstrasse 43, 8004 z			S Schweizerischer Kalibrierdi Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accre The Swiss Accreditation Set Multilateral Agreement for the	rvice is one of the signati he recognition of calibrat	ories to the EA ion certificates	Accreditation No.: SCS 0108
Client CCIC-HTW (Certific	ate No: D2450V2-1009_Feb1
CALIBRATION	CERTIFICAT	TE	A REAL PROPERTY AND A REAL
Object	D2450V2 - SN	1009	STATISTICS STATISTICS
Calibration procedure(s)	QA CAL-05.v9 Calibration prod	cedure for dipole validation kits	above 700 MHz
Calibration date:	February 05, 20	018	
Calibration Equipment used (Me Primary Standards	&TE critical for calibration)	Cal Date (Certificate No.)	
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18 Apr-18
Type-N mismatch combination	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Set a	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Helerence Prohe EYanua	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	
Reference Probe EX3DV4 DAE4	SN: 601	and the second sec	Dec-18
		26-Oct-17 (No. DAE4-601_Oct17)	1220.000
DAE4 Secondary Standards	ID#	26-Oct-17 (No. DAE4-601_Oct17)	Dec-18 Oct-18
DAE4 Secondary Standards Power meter EPM-442A	SN: GB37480704	26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	Dec-18 Oct-18 Scheduled Check
DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: GB37480704 SN: US37292783	26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	Dec-18 Oct-18 Scheduled Check In house check: Oct-18
DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	SN: GB37480704	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)	Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-05	SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	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)	Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	SN: GB37490704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	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)	Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18
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	SN: GB37490704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585 Name	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) 15-Jun-15 (in house check Oct-17) Function	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
DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-05	SN: GB37490704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	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) 15-Jun-15 (in house check Oct-17)	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

Certificate No: D2450V2-1009_Feb18

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Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



s C s

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D2450V2-1009_Feb18

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Measurement Conditions

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

DASY Version	DASY5	
Extrapolation	Advanced Extrapolation	V52.10.0
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	100000000000
Zoom Scan Resolution	dx, dy, dz = 5 mm	with Spacer
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

Temperature	Permittivity	Conductivity
22.0 °C		Conductivity
(22.0 ± 0.2) °C		1.80 mho/m
		1.87 mho/m ± 6 %
		22.0 °C 39.2 (22.0 ± 0.2) °C 37.9 ± 6 %

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.5 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
		and the second se
SAR measured	250 mW input power	6.13 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	51.4 ± 6 %	2.04 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		2.04 11/0/11/20 //

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	49.4 W/kg ± 17.0 % (k=2)
SAD averaged to the state		
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR averaged over 10 cm ⁴ (10 g) of Body TSL SAR measured	250 mW input power	5.92 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	
Return Loss	53.8 Ω + 2.2 jΩ
Loss .	- 27.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	
Return Loss	49.9 Ω + 4.6 jΩ
Heldin Loss	- 26.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	
	1.152 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 according to the Standard. The SAR data are not affected by this change. The overall dipole length is still No excession force matching.

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	
manufactured by	SPEAG
Manufactured on	
	October 17, 2017

Certificate No: D2450V2-1009_Feb18

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Date: 05.02.2018

DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

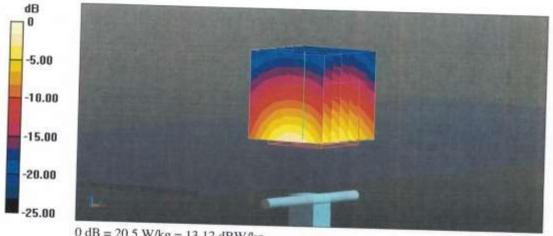
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:1009

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = 1.87$ S/m; $\epsilon_f = 37.9$; $\rho = 1000$ kg/m³ 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) ٠
- 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) ٠

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 = 111.8 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 26.6 W/kg SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.13 W/kg Maximum value of SAR (measured) = 20.5 W/kg

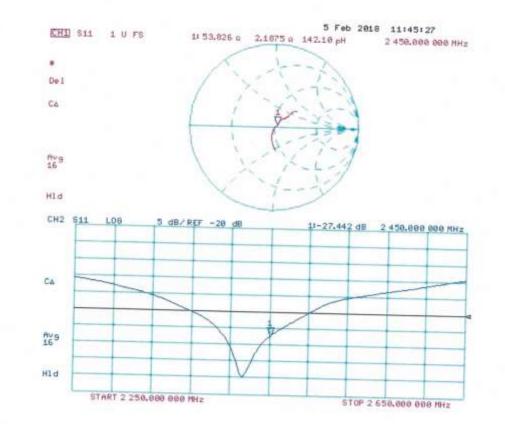


0 dB = 20.5 W/kg = 13.12 dBW/kg

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Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-1009_Feb18

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Date: 05.02.2018

DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

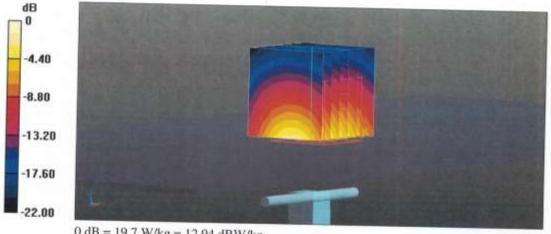
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:1009

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 2.04 S/m; ϵ_r = 51.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.01, 8.01, 8.01); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) ٠
- 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 = 104.2 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 25.5 W/kg SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.92 W/kg Maximum value of SAR (measured) = 19.7 W/kg

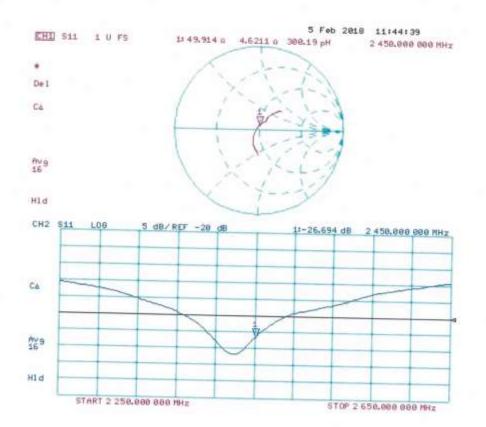


0 dB = 19.7 W/kg = 12.94 dBW/kg

Certificate No: D2450V2-1009_Feb18

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Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-1009_Feb18

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1.5. D5GHzV2 Dipole Calibration Certificate

credited by the Swiss Accredita a Swiss Accreditation Servic Itilateral Agreement for the n	e is one of the signatorie		Accreditation No.: SCS 0108
ent CCIC-HTW (Au	iden)	Certificate	No: D5GHzV2-1273_Feb18
ALIBRATION O	CERTIFICATI		
ject	D5GHzV2 - SN:	1273	
libration procedure(s)	QA CAL-22.v2		
	Calibration proce	edure for dipole validation kits b	etween 3-6 GHz
ibration date:	February 21, 201	18	
	1 00/001/ 21, 20		
		vobability are given on the following pages	
calibrations have been conduc	cted in the closed laborato	robability are given on the following pages ry facility: environment temperature (22 ± 3	
	cted in the closed laborato		
calibrations have been conduction Equipment used (M&) many Standards wer meter NRP	Cted in the closed laborato	ry facility: environment temperature (22 ±) Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	3)°C and humidity < 70%. Scheduled Calibration Apr-18
calibrations have been conduc ibration Equipment used (M&) nary Standards ver meter NRP ver sensor NRP-Z91	Cted in the closed laborato	ry facility: environment temperature (22 ±) Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	3)°C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18
calibrations have been conduc ibration Equipment used (M& nary Standards ver meter NRP ver sensor NRP-Z91 ver sensor NRP-Z91	Cted in the closed laborato	ry facility: environment temperature (22 ± 2 Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	3)°C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18
calibrations have been conduction Equipment used (M&) nary Standards ver meter NRP ver sensor NRP-Z91 ver sensor NRP-Z91 erence 20 dB Attenuator	Cted in the closed laborato	ry facility: environment temperature (22 ±) Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	3)°C and humidity < 70%. Scheduled Calibration Apr-18 Apr-18 Apr-18 Apr-18 Apr-18
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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Schweizerischer Kalibrierdienst

C Service suisse d'étalonnage

Servizio svizzero di taratura Surias Calibration Sandas

Accreditation No.: SCS 0108

S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D5GHzV2-1273_Feb18

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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 5500 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	36.4 ± 6 %	4.53 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	7.98 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5300 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	4.64 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.4 W / kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 100 mW input power	2.34 W/kg

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.0 ± 6 %	4.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	86.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	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 %	4.95 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	19 <u>6010</u> 1	

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	8.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.9 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	2.40 W/kg

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) "C	35.5 ± 6 %	5.16 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	1444	

SAR result with Head TSL at 5800 MHz

100 mW input power	7.94 W/kg
normalized to 1W	79.4 W/kg ± 19.9 % (k=2)
condition	
100 mW input power	2.25 W/kg
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	condition

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Body TSL parameters at 5200 MHz The following parameters and calculations were applied.

	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	47.5 ± 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	7.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.6 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	2.05 W/kg

Body TSL parameters at 5300 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.54 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	100	

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.6 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg

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Body TSL parameters at 5500 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.80 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		7772

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.3 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	2.23 W/kg

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 "C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.95 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	7.99 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.1 W/kg ± 19.5 % (k=2)

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Body TSL parameters at 5800 MHz The following parameters and calculations were applied.

	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	46.4 ± 6 %	6.23 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	7.70 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.5 W/kg ± 19.9 % (k=2)
	and the second state of th	
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	2.13 W/kg

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	47.8 Ω - 3.3 jΩ	
Return Loss	- 27.9 dB	

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.3 Ω + 0.8 jΩ	
Return Loss	- 34.3 dB	

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	47.8 Ω + 1.6 jΩ	
Return Loss	- 31.2 dB	

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.2 Ω + 2.1 jΩ	
Return Loss	- 28.7 dB	

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.5 Ω + 3.4 jΩ	
Return Loss	- 27.8 dB	

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	47.8 Ω - 3.1 jΩ	
Return Loss	- 28.3 dB	

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.4 Ω + 2.3 jΩ
Return Loss	- 30.8 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	48.4 Ω + 2.0 jΩ	
Return Loss	- 31.6 dB	

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Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	52.7 Ω + 4.2 jΩ	
Return Loss	- 26.3 dB	

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	52.4 Ω + 5.2 jΩ	
Return Loss	- 25.1 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 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	July 19, 2017

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DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1273

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 4.53 \text{ S/m}$; $\varepsilon_r = 36.4$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5300 MHz; $\sigma = 4.64 \text{ S/m}$; $\epsilon_r = 36.3$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5500 MHz; $\sigma = 4.84 \text{ S/m}$; $\epsilon_r = 36$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5600 MHz; $\sigma = 4.95 \text{ S/m}$; $\epsilon_r = 35.8$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5800 MHz; $\sigma = 5.16$ S/m; $\epsilon_r = 35.5$; $\rho = 1000$ kg/m³ 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(5.2, 5.2, 5.2); 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 = 70.07 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 28.9 W/kg SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.28 W/kg Maximum value of SAR (measured) = 18.1 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 = 70.58 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 29.8 W/kg SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.34 W/kg Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 71.24 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 33.7 W/kg SAR(1 g) = 8.59 W/kg; SAR(10 g) = 2.44 W/kg Maximum value of SAR (measured) = 20.1 W/kg

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Date: 21.02.2018

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 = 70.41 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 32.5 W/kg SAR(1 g) = 8.39 W/kg; SAR(10 g) = 2.4 W/kg Maximum value of SAR (measured) = 19.8 W/kg

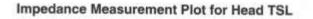
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 68.42 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 31.5 W/kg SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.25 W/kg Maximum value of SAR (measured) = 18.8 W/kg

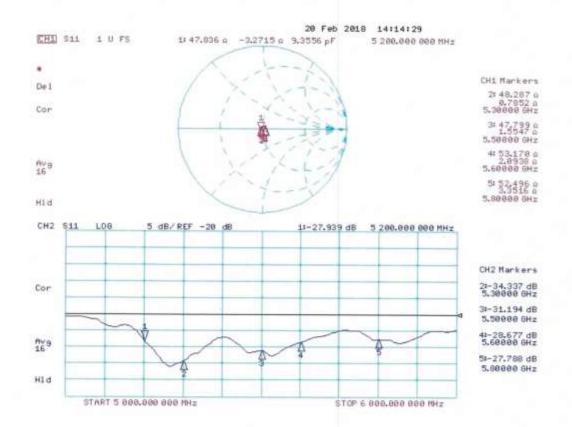


0 dB = 18.1 W/kg = 12.58 dBW/kg

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DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1273

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; σ = 5.41 S/m; ϵ_r = 47.5; ρ = 1000 kg/m³, Medium parameters used: f = 5300 MHz; σ = 5.54 S/m; ϵ_r = 47.3; ρ = 1000 kg/m³, Medium parameters used: f = 5500 MHz; σ = 5.8 S/m; ϵ_r = 47; ρ = 1000 kg/m³, Medium parameters used: f = 5600 MHz; σ = 5.95 S/m; ϵ_r = 46.8; ρ = 1000 kg/m³. Medium parameters used: f = 5800 MHz; σ = 6.23 S/m; ϵ_r = 46.4; ρ = 1000 kg/m³ 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(4.7, 4.7, 4.7); 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 = 65.97 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 28.0 W/kg SAR(1 g) = 7.4 W/kg; SAR(10 g) = 2.05 W/kg Maximum value of SAR (measured) = 17.2 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 = 65.85 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 29.8 W/kg SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.13 W/kg Maximum value of SAR (measured) = 17.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 67.13 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 33.5 W/kg SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.23 W/kg Maximum value of SAR (measured) = 19.5 W/kg

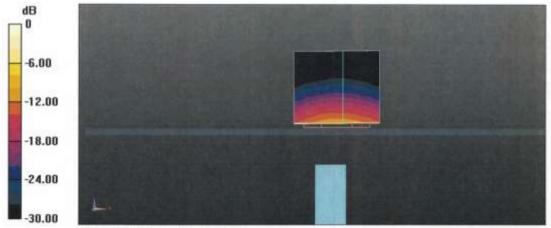
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Date: 20.02.2018

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 = 65.86 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 33.7 W/kg SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.23 W/kg Maximum value of SAR (measured) = 19.2 W/kg

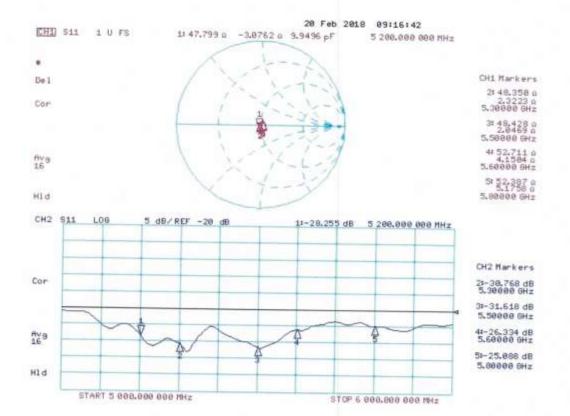
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.37 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 33.6 W/kg SAR(1 g) = 7.7 W/kg; SAR(10 g) = 2.13 W/kg Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 17.2 W/kg = 12.36 dBW/kg

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Impedance Measurement Plot for Body TSL



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