#### DASY5 Validation Report for Head TSL

Date: 19.05.2020

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1014

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.91 \text{ S/m}$ ;  $\varepsilon_c = 42.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 31.12.2019

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

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

Reference Value = 58.88 V/m; Power Drift = 0.00 dB

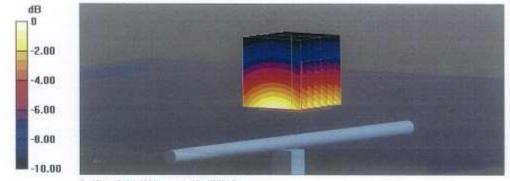
Peak SAR (extrapolated) = 3.18 W/kg

SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.40 W/kg

Smallest distance from peaks to all points 3 dB below = 18.4 mm

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

Maximum value of SAR (measured) = 2.81 W/kg



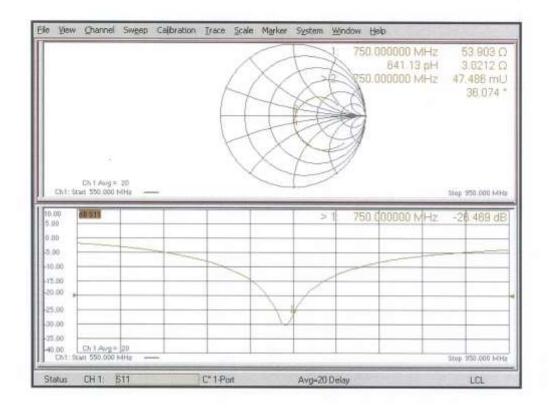
0 dB = 2.81 W/kg = 4.49 dBW/kg

Certificate No: D750V3-1014\_May20

Page 5 of 6

# FCC ID: A3LSMG990U

# Impedance Measurement Plot for Head TSL



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

HCT (Dymstec)





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

Accreditation No.: SCS 0108

Certificate No: D835V2-4d266\_Aug20

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

Agreement for the recognition of calibration certificates

	ERTIFICATE	2	당 당 작	의 인 자
414300		제	186	bi
Object	D835V2 - SN:4d2	266	IN I WINGE	45 1 4/18/AZ
		9 3	7-93 / 12.6	2010 110.6
Calibration procedure(s)	QA CAL-05.v11			1010 110,0
	Calibration Proce	edure for SAR Valid	ation Sources b	etween 0.7-3 GHz
Calibration date:	August 27, 2020			
This calibration certificate document The measurements and the uncert All calibrations have been conduct	aintles with confidence p	robability are given on the	following pages and a	re part of the certificate.
Calibration Equipment used (M&TE		***************************************		
Primary Standards	ID #	Cal Date (Certificate No	.)	Scheduled Calibration
ower meter NRP	SN: 104778	01-Apr-20 (No. 217-031	00/03101)	Apr-21
ower sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-031	00)	Apr-21
the second of the second of	SN: 103245	01-Apr-20 (No. 217-031	01)	Apr-21
dwar sensor NRP-Z91	Table 1 Village Co. 2000, A. bernanner et al.	the second of the second	06)	A
	SN: BH9394 (20k)	31-Mar-20 (No. 217-031		Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k) SN: 310982 / 06327	31-Mar-20 (No. 217-031	04)	Apr-21 Apr-21
Reference 20 dB Attenuator Type-N mismatch combination			Maria Caracana and	DOM: 1 (22.5)
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 310982 / 06327	31-Mar-20 (No. 217-031	(9_Jun20)	Apr-21
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 310982 / 06327 SN: 7349	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6	(9_Jun20)	Apr-21 Jun-21 Dec-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 310982 / 06327 SN: 7349 SN: 601	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-8 Check Date (In house)	(9_Jun20) 01_Dec19)	Apr-21 Jun-21 Dec-20 Scheduled Check
Reference 20 dB Attenuator  Type-N mismatch combination  Reference Probe EX3DV4  DAE4  Secondary Standards  Tower mater E4419B	SN: 310982 / 06327 SN: 7349 SN: 601	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6	(9_Jun20) (01_Dec19) lick Feb-19)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check; Oct-20
Reference 20 dB Attenuator  Type-N mismatch combination  Reference Probe EX3DV4  DAE4  Secondary Standards  Fower meter E4419B  Fower sensor HP 8481A	SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (In house) 30-Oct-14 (In house che 07-Oct-15 (In house che	89_Jun20) 01_Dec19) ack Feb-19) ack Oct-18)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check; Oct-20 In house check; Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Tower meter E4419B Tower sensor HP 8481A	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (In house) 30-Oct-14 (In house che 07-Oct-15 (In house che 07-Oct-15 (In house che	(9_Jun20) 01_Dec19) lick Feb-19) lick Oct-18)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference 20 dB Attenuator ype-N mismatch combination Reference Probe EX3DV4 IAE4 Recondary Standards Fower meter E4419B Fower sensor HP 8481A RE generator R&S SMT-06	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783 SN: MY41092317	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (In house) 30-Oct-14 (In house che 07-Oct-15 (In house che	(8_Jun20) 01_Dec19) lick Feb-19) lick Oct-18) lick Oct-18)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent EB358A	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (in house) 30-Oct-14 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che	(8_Jun20) 01_Dec19) lick Feb-19) lick Oct-18) lick Oct-18)	Apr-21 Jun-21 Oec-20 Scheduled Check In house check: Oct-20
Reference 20 dB Altenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent EB358A	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783 SN: MY41082317 SN: 100972 SN: US41080477	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (In house) 30-Oct-14 (In house che 07-Oct-15 (In house che 15-Jun-15 (In house che 31-Mar-14 (In house che Function	19_Jun20) 101_Dec19) lick Feb-19) lick Oct-18) lick Oct-18) lick Oct-18)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Becondary Standards Fower meter E4419B Fower sensor HP 8481A Fower sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent EB358A	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (in house) 30-Oct-14 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che	19_Jun20) 101_Dec19) lick Feb-19) lick Oct-18) lick Oct-18) lick Oct-18)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agitent EB358A Calibrated by:	SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Jeffrey Katzman	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (In house) 30-Oct-14 (In house che 07-Oct-15 (In house che 15-Jun-15 (In house che 31-Mar-14 (In house che Function	19_Jun20) 101_Dec19) 10k Feb-19) 10k Oct-18) 10k Oct-18) 10k Oct-18) 10k Oct-18)	Apr-21 Jun-21 Oec-20 Scheduled Check In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Becondary Standards Fower meter E4419B Fower sensor HP 8481A Fower sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent EB358A	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783 SN: MY41082317 SN: 100972 SN: US41080477	31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-734 27-Dec-19 (No. DAE4-6 Check Date (In house) 30-Oct-14 (In house che 07-Oct-15 (In house che 15-Jun-15 (In house che 31-Mar-14 (In house che Function	19_Jun20) 101_Dec19) 10k Feb-19) 10k Oct-18) 10k Oct-18) 10k Oct-18) 10k Oct-18)	Apr-21 Jun-21 Oec-20 Scheduled Check In house check: Oct-20

Certificate No: D835V2-4d266\_Aug20

Page 1 of 7

# Calibration Laboratory of Schmid & Partner Engineering AG





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

Accreditation No.: SCS 0108

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: D835V2-4d266\_Aug20

Page 2 of 7

#### Measurement Conditions

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

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

Head TSL parameters
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NAMED IN COLUMN TW

# SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.44 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.13 W/kg ± 16.5 % (k=2)

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.2 Ω - 2.4 jΩ	
Return Loss	- 32.5 dB	

#### General Antenna Parameters and Design

The state of the s	
Electrical Delay (one direction)	1.389 ns

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

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

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

#### Additional EUT Data

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

Certificate No: D835V2-4d266\_Aug20

Page 4 of 7

# **DASY5 Validation Report for Head TSL**

Date: 27.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d266

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

Medium parameters used: f = 835 MHz;  $\sigma = 0.93$  S/m;  $\epsilon_c = 42.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

# DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated; 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

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

Reference Value = 62.47 V/m; Power Drift = -0.02 dB

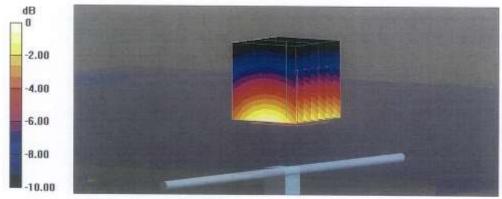
Peak SAR (extrapolated) = 3.57 W/kg

# SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.56 W/kg

Smallest distance from peaks to all points 3 dB below = 16 mm

Ratio of SAR at M2 to SAR at M1 = 67.2%

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

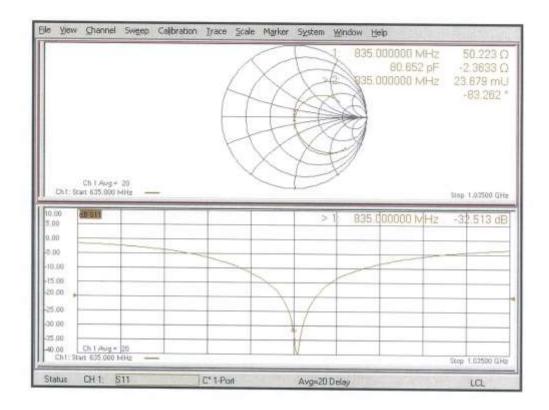


0 dB = 3.19 W/kg = 5.04 dBW/kg

Certificate No: D835V2-4d266\_Aug20

Page 5 of 7

# Impedance Measurement Plot for Head TSL



# Appendix: Transfer Calibration at Four Validation Locations on SAM Head1

#### **Evaluation Condition**

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L
---------	------------------	-----------------------------

# SAR result with SAM Head (Top ≅ C0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	8.97 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.42 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm3 (10 g) of Head TSL	condition	

# SAR result with SAM Head (Neck ≅ H0)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	8.95 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Ear D90)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	7.69 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	5.17 W/kg ± 16.9 % (k=2)

Certificate No: D835V2-4d266\_Aug20

Additional assessments outside the current scope of SCS 0108

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





Schweizerischer Kalibrierdienst 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

Accreditation No.: SCS 0108

Client HCT (Dymstec) Certificate No: D1800V2-2d007\_Aug20

CALIBRATION C	ERTIFICATI	3 -	한 당,작	의 인 자
		재	00	W.
Object	D1800V2 - SN:20	1007	77.77.77	-
		1 1 4 102	And the second s	2020 1 10 6
Calibration procedure(s)	QA CAL-05.v11	CONTRACTOR OF THE PARTY OF THE	7 1 1 1	1010 1 10.6
1.00 (1.00)#0000#0303 <b>#</b> 0#1.		dure for SAR Validat	ion Sources	between 0.7-3 GHz
		very fet acht transact	1011 5001 500	DOLWOOT O.T-D GITZ
Calibration date:	August 26, 2020			
This calibration auditionts danismost	order. How from the wife ITM a decision of	and the second s		
This calibration certificate docume	nts the traceability to natio	onal standards, which realize	the physical uni	its of measurements (SI).
he measurements and the uncert	arribes with connoence pr	obability are given on the fol	owing pages an	d are part of the certificate.
	WANTE OF THE PARTY	774 H		
A calibrations have been conduct			make one office of garden	
	ed in the dosed appraign	y facility: environment tempe	tatrite (XX # 3), C	and humidity < 70%.
		y facility: environment tempe	rature (22 ± 3) C	3 and humidity < 70%.
		y facility: environment tempe	rature (22 ± 3) C	3 and humidity < 70%.
Calibration Equipment used (M&Tt			rature (22 ± 3) C	157.
Calibration Equipment used (M&TE	E critical for calibration)	Cal Date (Certificate No.)		Scheduled Calibration
salibration Equipment used (M&TE rimary Standards ower meter NRP	E critical for calibration)		/03101)	Scheduled Calibration Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91	E critical for calibration)  ID #  SN: 104778	Call Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100	/03101) )	Scheduled Calibration Apr-21 Apr-21
Calibration Equipment used (M&TE frimary Standards Tower meter NRP Tower sensor NRP-Z91 Tower sensor NRP-Z91	ID # SN: 104778 SN: 103244 SN: 103245	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101	(03101) )	Scheduled Calibration Apr-21 Apr-21 Apr-21
rimary Standards rower meter NRP rower sensor NRP-Z91 rower sensor NRP-Z91 rower sensor NRP-Z91 rower sensor NRP-Z91 reference 20 dB Attenuator	E critical for calibration)  ID #  SN: 104778 SN: 103244	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03106	(103101) ) ) )	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Fower sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	ID # SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k)	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03104 31-Mar-20 (No. 217-03104	(103101) ) ) ) i)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
calibration Equipment used (M&Te trimary Standards Tower meter NRP Tower sensor NRP-Z91 tower sensor NRP-Z91 telerence 20 dB Attenuator ype-N mismatch combination telerence Probe EX3DV4	ID # SN: 104778 SN: 103244 SN: 103245 SN: 8149394 (20k) SN: 310982 / 06327 SN: 7349	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03104 31-Mar-20 (No. 217-03104 29-Jun-20 (No. EX3-7349	(03101) ) ) )) )) )) Jun20)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 teference 20 dB Attenuator type-N mismatch combination teference Probe EX3DV4	ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03104 31-Mar-20 (No. 217-03104	(03101) ) ) )) )) )) Jun20)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
Calibration Equipment used (M&TE Primary Standards Prower meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4 RAE4 Recondary Standards	ID # SN: 104778 SN: 103244 SN: 103245 SN: 8149394 (20k) SN: 310982 / 06327 SN: 7349	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03104 31-Mar-20 (No. 217-03104 29-Jun-20 (No. EX3-7349	(03101) ) ) )) )) )) Jun20)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21
Calibration Equipment used (M&TE Primary Standards Prower meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4 RAE4 Recondary Standards Power meter E4419B	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: G839512475	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03104 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601	(03101) ) ) ) ) ) ) ) Jun20) _Dec19)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20
Calibration Equipment used (M&Te Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination becondary Probe EX30V4 AAE4	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	Call Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 31-Mar-20 (No. 217-03100 31-Mar-20 (No. 217-03100 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601	(03101) ) ) ) ) ) ) jun20) _Dec19)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check
calibration Equipment used (M&Te frimary Standards frower meter NRP frower sensor NRP-Z91 frower sensor NRP-Z91 teference 20 dB Attenuator ype-N mismatch combination beference Probe EX30V4 AE4	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: G839512475	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03104 28-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house)	(03101) ) ) ) ) ) ) ) ) Jun20) _Dec19) Feb-19) Oct-18)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check; Oct-20
calibration Equipment used (M&Te frimary Standards frower meter NRP Fower sensor NRP-Z91 fower sensor NRP-Z91 teleference 20 dB Attenuator ype-N mismatch combination leference Probe EX30V4 IAE4 econdary Standards fower meter E4419B fower sensor HP 8481A	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: G839512475 SN: US37292783	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03102 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house check 07-Oct-15 (in house check	V03101) ) ) ) ) ) ) ) ) Jun20) _Dec19) Feb-19) Oct-18)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
calibration Equipment used (M&Te rimary Standards fower meter NRP fower sensor NRP-Z91 foreignessensor NRP-Z91 feference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 IAE4 secondary Standards fower meter E4419B fower sensor HP 8481A fower sensor HP 8481A	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: G839512475 SN: US37292783 SN: MY41092317	Cail Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03104 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house check 07-Oct-15 (in house check	V03101) ) ) ) ) ) ) jun20) _Dec19) Feb-19) Oct-18) Oct-18)	Scheduled Calibration  Apr-21  Apr-21  Apr-21  Apr-21  Apr-21  Jun-21  Dec-20  Scheduled Check  In house check: Oct-20  In house check: Oct-20  In house check: Oct-20  In house check: Oct-20
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Ceference 20 dB Attenuator ype-N mismatch combination beference Probe EX30V4 AAE4 Secondary Standards Power meter E4419B Cower sensor HP 8481A USE generator R&S SMT-06	ID # SN: 104778 SN: 103244 SN: 103245 SN: 8149394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: G839512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03104 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house check 07-Oct-15 (in house check 07-Oct-15 (in house check 15-Jun-15 (in house check 31-Mar-14 (in house check	V03101) ) ) ) ) ) ) jun20) _Dec19) Feb-19) Oct-18) Oct-18)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 RAE4 Recondary Standards Power meter E4419B Rower sensor HP 8481A Rower sensor HP 8481A Reference RAS SMT-06 Retwork Analyzer Agilant E8358A	ID # SN: 104778 SN: 103244 SN: 103245 SN: 819394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: G839512475 SN: US37292783 SN: MY41092317 SN: US41060477 Name	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03101 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house check 07-Oct-15 (in house check 15-Jun-15 (in house check 31-Mar-14 (in house check	(03101) ) ) )) )) )) )) ,Jun20) _Dec19)  Feb-19) Oct-18) Oct-18) Oct-18) (Oct-18)	Scheduled Calibration  Apr-21  Apr-21  Apr-21  Apr-21  Apr-21  Jun-21  Dec-20  Scheduled Check  In house check; Oct-20  In house check; Oct-20
rimary Standards ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 iderence 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 iAE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 etwork Analyzer Agilent E8358A	ID # SN: 104778 SN: 103244 SN: 103245 SN: 8149394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: G839512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03104 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house check 07-Oct-15 (in house check 07-Oct-15 (in house check 15-Jun-15 (in house check 31-Mar-14 (in house check	(03101) ) ) )) )) )) )) ,Jun20) _Dec19)  Feb-19) Oct-18) Oct-18) Oct-18) (Oct-18)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probs EX30V4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Reference R&S SMT-06 Network Analyzer Agilient E8358A	ID # SN: 104778 SN: 103244 SN: 103245 SN: 819394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: G839512475 SN: US37292783 SN: MY41092317 SN: US41060477 Name	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03101 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house check 07-Oct-15 (in house check 15-Jun-15 (in house check 31-Mar-14 (in house check	(03101) ) ) )) )) )) )) ,Jun20) _Dec19)  Feb-19) Oct-18) Oct-18) Oct-18) (Oct-18)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Calibration Equipment used (M&Te Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Reference R&S SMT-06 Network Analyzer Agilient E8358A Calibrated by:	ID # SN: 104778 SN: 103244 SN: 103245 SN: 819394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: G839512475 SN: US37292783 SN: MY41092317 SN: US41060477 Name	Cai Date (Certificate No.) 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03100 01-Apr-20 (No. 217-03101 31-Mar-20 (No. 217-03101 31-Mar-20 (No. 217-03101 29-Jun-20 (No. EX3-7349 27-Dec-19 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house check 07-Oct-15 (in house check 15-Jun-15 (in house check 31-Mar-14 (in house check	(03101) ) ) ) ) ) ) ) ) ) Jun20) _Dec19)  Feb-19) Oct-18) Oct-18) Oct-18) Cot-18) chinician	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20

Certificate No: D1800V2-2d007\_Aug20

Page 1 of 6

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





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

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: SCS 0108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A not applicable or not measured

# Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- EC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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: D1800V2-2d007 Aug20

Page 2 of 6

# **Measurement Conditions**

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 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	40.4 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.7 W/kg ± 16.5 % (k=2)

Certificate No: D1800V2-2d007\_Aug20

# Appendix (Additional assessments outside the scope of SCS 0108)

# Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.2 Ω - 7.7 jΩ	
Return Loss	- 21.0 dB	

# General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 ns

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

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

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

#### Additional EUT Data

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

Certificate No: D1800V2-2d007\_Aug20

Page 4 of 6

#### **DASY5 Validation Report for Head TSL**

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d007

Communication System: UID 0 - CW; Frequency: 1800 MHz

Medium parameters used: f = 1800 MHz;  $\sigma = 1.38 \text{ S/m}$ ;  $\varepsilon_r = 40.4$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.38, 8.38, 8.38) @ 1800 MHz; Calibrated: 29.06,2020

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 106.8 V/m; Power Drift = 0.04 dB

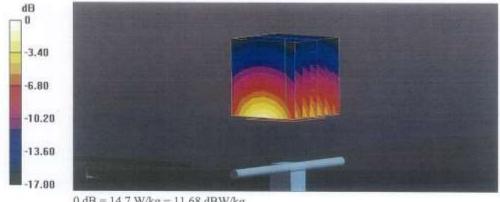
Peak SAR (extrapolated) = 17.7 W/kg

SAR(1 g) = 9.43 W/kg; SAR(10 g) = 4.9 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 53.8%

Maximum value of SAR (measured) = 14.7 W/kg

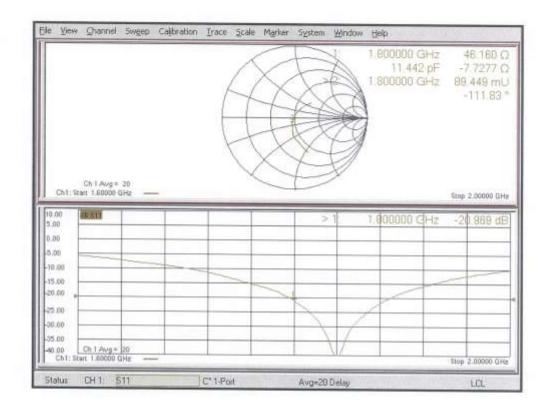


0 dB = 14.7 W/kg = 11.68 dBW/kg

Certificate No: D1800V2-2d007\_Aug20

Page 5 of 6

# Impedance Measurement Plot for Head TSL



Certificate No: D1800V2-2d007\_Aug20

Page 6 of 6

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





Schweizerischer Kalibrierdienst 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

Accreditation No.: SCS 0108

Client HCT (Dymstec) Certificate No: D1900V2-5d032\_Jan21

CALIBRATION C	ERTIFICATE	73	담당자	확인자
Object	D1900V2 - SN:56	1032 재	DE VIX 3	19114
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Valida		
Calibration date:	January 28, 2021			
This calibration certificate documer The measurements and the uncert All calibrations have been conduct Calibration Equipment used (M&TE	ainties with confidence p	robability are given on the fi	ollowing pages and ar	re part of the certificate.
Primary Standards	ID#	Cal Date (Certificate No.)	0	Scheduled Calibration
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 31-Mar-20 (No. 217-0310 31-Mar-20 (No. 217-0310 28-Dec-20 (No. EX3-734 02-Nov-20 (No. DAE4-60	0) 11) 06) 14) 9_Dec20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21
	ID#	Check Date (in house)		Scheduled Check
Secondary Standards				
Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-05 Network Analyzer Agilent E8358A	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	30-Oct-14 (in house chec 07-Oct-15 (in house chec 07-Oct-15 (in house chec 15-Jun-15 (in house chec 31-Mar-14 (in house chec	sk Oct-20) sk Oct-20) sk Oct-20)	In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21
Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-05	SN: US37292783 SN: MY41092317 SN: 100972	30-Oct-14 (in house chec 07-Oct-15 (in house chec 07-Oct-15 (in house chec 15-Jun-15 (in house chec	ck Oct-20) ck Oct-20) ck Oct-20) ck Oct-20)	In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21
Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	30-Oct-14 (in house chec 07-Oct-15 (in house chec 07-Oct-15 (in house chec 15-Jun-15 (in house chec 31-Mar-14 (in house chec Function	de Oct-20) de Oct-20) de Oct-20) de Oct-20) de Oct-20)	In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21

Certificate No: D1900V2-5d032\_Jan21

Page 1 of 6

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





Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura Swisa 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 N/A sensitivity in TSL / NORM x,y,z not applicable or not measured

Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D1900V2-5d032\_Jan21

Page 2 of 6

# **Measurement Conditions**

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

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

# Head TSL parameters The following parameters

he following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.2 ± 6 %	1.39 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.0 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg ± 16.5 % (k=2)

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.4 \Omega + 7.4 j\Omega$	
Return Loss	- 22.6 dB	

# General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns	
----------------------------------	----------	--

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

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

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

#### **Additional EUT Data**

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

Certificate No: D1900V2-5d032\_Jan21

Page 4 of 6

# **DASY5 Validation Report for Head TSL**

Date: 28.01.2021

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032

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

Medium parameters used: f = 1900 MHz;  $\sigma = 1.39$  S/m;  $\varepsilon_r = 41.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

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

Reference Value = 109.8 V/m; Power Drift = -0.02 dB

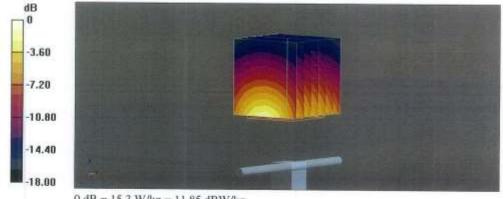
Peak SAR (extrapolated) = 18.2 W/kg

SAR(1 g) = 9.89 W/kg; SAR(10 g) = 5.17 W/kg

Smallest distance from peaks to all points 3 dB below = 9.5 mm

Ratio of SAR at M2 to SAR at M1 = 54.9%

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

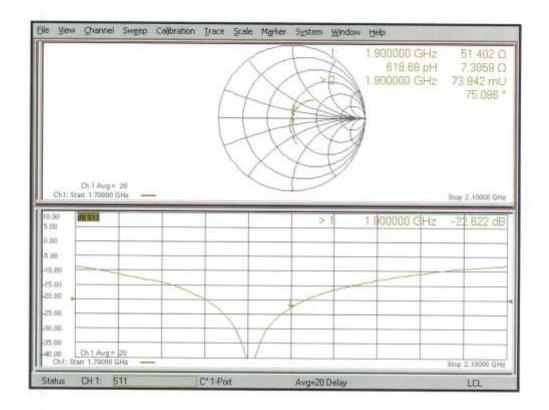


0 dB = 15.3 W/kg = 11.85 dBW/kg

Certificate No: D1900V2-5d032\_Jan21

Page 5 of 6

# Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d032\_Jan21

Page 6 of 6

#### Calibration Laboratory of Schweizerischer Kalibrierdienst Schmid & Partner Service suisse d'étalonnage Engineering AG Servizio svizzero di taratura Zeughausstrasse 43, 8004 Zurich, Switzerland S Swiss Calibration Service Accredited by the Swiss Accreditation Service (SAS) Accreditation No.: SCS 0108 The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates HCT (Dymstec) Certificate No: D2300V2-1010\_Aug20 CALIBRATION CERTIFICATE Object D2300V2 - SN:1010 2020 2010/12. Calibration procedure(s) QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz Calibration date: August 26, 2020 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed faboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID# Cal Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 01-Apr-20 (No. 217-03100/03101) Apr-21 Power sensor NRP-Z91 SN: 103244 01-Apr-20 (No. 217-03100) Apr-21 Power sensor NRP-Z91 SN: 103245 01-Apr-20 (No. 217-03101) Apr-21 Reference 20 dB Attenuator SN: BH9394 (20k) 31-Mar-20 (No. 217-03106) Apr-21 Type-N mismatch combination SN: 310982 / 06327 31-Mar-20 (No. 217-03104) Apr-21 Reference Probe EX3DV4 SN: 7349 29-Jun-20 (No. EX3-7349\_Jun20) Jun-21 DAE4 SN: 601 27-Dec-19 (No. DAE4-601\_Dec19) Dec-20 Secondary Standards ID# Check Date (in house) Scheduled Check Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Feb-19) In house check: Oct-20 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-18) In house check: Oct-20 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-18) In house chedi: Oct-20 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-18) In house check: Oct-20 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-19) in house check: Oct-20 Name Function Calibrated by: Last Klysnee Laboratory Technician Approved by: Katja Pokovio Technical Manager

Certificate No: D2300V2-1010\_Aug20

Page 1 of 6

This calibration certificate shall not be reproduced except in full without written approval of the laboratory

Issued: August 27, 2020

# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

#### Glossary:

TSL

tissue simulating liquid

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- EC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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: D2300V2-1010\_Aug20

Page 2 of 6

# **Measurement Conditions**

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

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

Head TSL parameters
The following parameters and calculations were applied.

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

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	48.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 16.5 % (k=2)

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.5 Ω - 2.6 JΩ	
Return Loss	- 30.4 dB	

# General Antenna Parameters and Design

Electrical Delay (one direction)	1.170 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
monarday by	SPEAG

Certificate No: D2300V2-1010\_Aug20

Page 4 of 6

# **DASY5 Validation Report for Head TSL**

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1010

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

Medium parameters used: f = 2300 MHz;  $\sigma = 1.68$  S/m;  $\epsilon_r = 39.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

# DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(7.82, 7.82, 7.82) @ 2300 MHz; Calibrated: 29.06.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 27.12.2019

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

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

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

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

Reference Value = 114.4 V/m; Power Drift = 0.00 dB

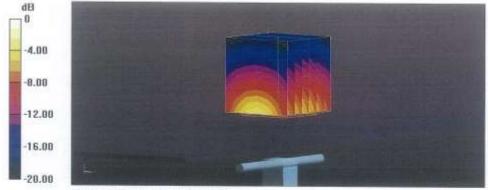
Peak SAR (extrapolated) = 22.7 W/kg

SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.88 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 53.7%

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



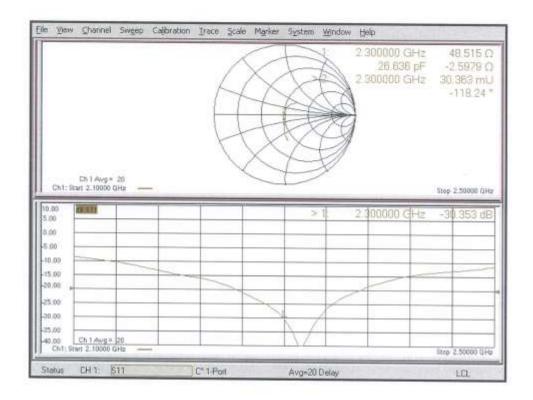
0 dB = 19.2 W/kg = 12.83 dBW/kg

Certificate No: D2300V2-1010\_Aug20

Page 5 of 6

# FCC ID: A3LSMG990U

# Impedance Measurement Plot for Head TSL



Certificate No: D2300V2-1010\_Aug20

Page 6 of 6

# Calibration Laboratory of Schmid & Partner





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

Accreditation No.: SCS 0108

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

Certificate No: D2450V2-1049 Aug20

CALIBRATION C	ERTIFICATE	절 되 차 자	위 인 최
		79/	120
Object	D2450V2 - SN:10	049   T   5   6   7   7   7   7   7   7   7   7   7	1010 / 10.6
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	
Calibration date:	August 26, 2020		
	ed in the closed laborator	robability are given on the following pages and $y$ facility: environment temperature $(22\pm3)^{\circ}C$	
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101)	Apr-21 Apr-21 Apr-21
	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 819364 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	31-Mar-20 (No. 217-03104) 31-Mar-20 (No. EX3-7349_Jun20) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-801_Dec19)	Apr-21 Jur-21 Dec-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Apr-21 Jun-21 Dec-20  Scheduled Check In house check: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun-20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 310882 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house sheck: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilant E8358A	SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE-4-601_Dec-19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19) Function	Apr-21 Jun-21 Dec-20  Scheduled Check In house check: Oct-20

Certificate No: D2450V2-1049\_Aug20

Page 1 of 7

#### 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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

#### Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A

not applicable or not measured

#### Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D2450V2-1049 Aug20

Page 2 of 7

# **Measurement Conditions**

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

Market and the National Association (Control of the Control of the	
Advanced Extrapolation	
Modular Flat Phantom	
10 mm	with Spacer
dx, dy, dz = 5 mm	
2450 MHz ± 1 MHz	
	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	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.1 W/kg ± 16.5 % (k=2)

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.5 Ω + 8.5 ]Ω	
Return Loss	- 21.4 dB	

# General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 ns

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

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

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

#### Additional EUT Data

Manufactured by	SPEAG

Certificate No: D2450V2-1049\_Aug20

Page 4 of 7

## **DASY5 Validation Report for Head TSL**

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:1049

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

Medium parameters used: f = 2450 MHz;  $\sigma = 1.84$  S/m;  $\epsilon_r = 38.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(7.74, 7.74, 7.74) @ 2450 MHz; Calibrated: 29.06.2020

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 115.7 V/m; Power Drift = -0.02 dB

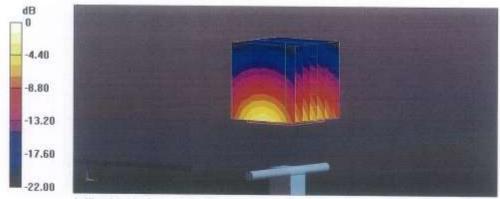
Peak SAR (extrapolated) = 25.5 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.06 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 51.3%

Maximum value of SAR (measured) = 21.4 W/kg

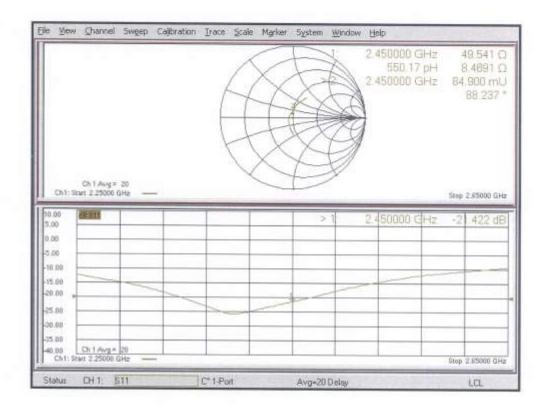


0 dB = 21.4 W/kg = 13.30 dBW/kg

Certificate No: D2450V2-1049\_Aug20

Page 5 of 7

# Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-1049\_Aug20

Page 6 of 7

# Appendix: Transfer Calibration at Four Validation Locations on SAM Head1

#### **Evaluation Condition**

The state of the s	The state of the s	
Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

# SAR result with SAM Head (Top ≅ C0)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	54.8 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	55.9 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Neck ≅ H0)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	52.6 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Control Menual Control	
SALE averaged over 10 cm- (10 g) of Head 12F	condition	

# SAR result with SAM Head (Ear ≅ D90)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	33.7 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	condition	
1 4		

Certificate No: D2450V2-1049\_Aug20

Page 7 of 7

Additional assessments outside the current scope of SCS 0108

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

HCT (Dymstec)





Schweizerischer Kalibrierdienst S Service suisse d'étalonnage C 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 Accreditation No.: SCS 0108

Certificate No: D2600V2-1015\_Aug20 CALIBRATION CERTIFICATE Object D2600V2 - SN:1015 1 1/54 2020 1 10.6 2020 Calibration procedure(s) QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz Calibration date: August 26, 2020 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID# Cal Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 01-Apr-20 (No. 217-03100/03101) Apr-21 Power sensor NRP-Z91 SN: 103244 01-Apr-20 (No. 217-03100) Apr-21 Power sensor NRP-Z91 SN: 103245 01-Apr-20 (No. 217-03101) Apr-21 Reference 20 dB Attenuator SN: BH9394 (20k) 31-Mar-20 (No. 217-03106) Apr-21 Type-N mismatch combination SN: 310982 / 06327 31-Mar-20 (No. 217-03104) Apr-21 Reference Probe EX3DV4 SN: 7349 29-Jun-20 (No. EX3-7349\_Jun20) Jun-21 DAE4 SN: 601 27-Dec-19 (No. DAE4-601\_Dec19) Dec-20 Secondary Standards Check Date (in house) Scheduled Check Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Feb-19) In house check: Oct-20 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-18) In house check: Oct-20 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-18) In house check: Oct-20 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-18) In house check: Oct-20 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-19) In house check: Oct-20

Calibrated by: Leif Klyaner Laboratory Technician Approved by: Katta Pokovic Technical Manager

Function

Issued: August 27, 2020

Certificate No: D2600V2-1015 Aug20

Name

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Page 1 of 6

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





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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

#### Glossary:

TSL

tissue simulating liquid

ConvF N/A

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

# Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D2600V2-1015 Aug20

Page 2 of 6

#### Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

#### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.3 ± 6 %	2.01 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-	-

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.4 W/kg ± 16.5 % (k=2)

Certificate No: D2600V2-1015\_Aug20

#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1 Ω - 4.0 jΩ	
Return Loss	- 27.7 dB	

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns
The state of the s	

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
The state of the s	

Certificate No: D2600V2-1015\_Aug20

Page 4 of 6

### **DASY5 Validation Report for Head TSL**

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1015

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

Medium parameters used: f = 2600 MHz;  $\sigma = 2.01 \text{ S/m}$ ;  $\epsilon_r = 38.3$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(7.54, 7.54, 7.54) @ 2600 MHz; Calibrated: 29.06.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 27.12.2019

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

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

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

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

Reference Value = 117.6 V/m; Power Drift = -0.01 dB

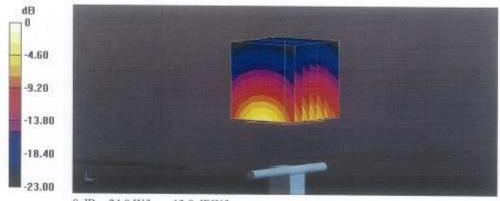
Peak SAR (extrapolated) = 28.6 W/kg

#### SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.42 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 50.2%

Maximum value of SAR (measured) = 24.0 W/kg

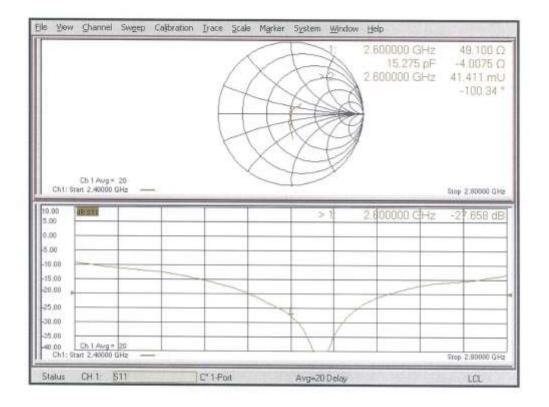


0 dB = 24.0 W/kg = 13.8 dBW/kg

Certificate No: D2600V2-1015 Aug20

Page 5 of 6

### Impedance Measurement Plot for Head TSL



Certificate No: D2600V2-1015\_Aug20

Page 6 of 6

### Calibration Laboratory of Schmid & Partner Engineering AG





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

Accreditation No.: SCS 0108

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

HCT (Dymstec) Certificate No: D3500V2-1040\_Feb21

CALIBRATION CERTIFICATE 0] Object D3500V2 - SN:1040 재 H328 时公司 Calibration procedure(s) QA CAL-22.v6 Calibration Procedure for SAR Validation Sources between 3-10 GHz Calibration date: February 17, 2021 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID# Cal Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 01-Apr-20 (No. 217-03100/03101) Power sensor NRP-Z91 SN: 103244 01-Apr-20 (No. 217-03100) Apr-21 Power sensor NRP-Z91 SN: 103245 01-Apr-20 (No. 217-03101) Apr-21 Reference 20 dB Attenuator SN: BH9394 (20k) 31-Mar-20 (No. 217-03106) Apr-21 Type-N mismatch combination SN: 310982 / 06327 31-Mar-20 (No. 217-03104) Apr-21 Reference Probe EX3DV4 SN: 3503 30-Dec-20 (No. EX3-3503\_Dec20) Dec-21 DAF4 SN: 601 02-Nov-20 (No. DAE4-601\_Nov20) Nov-21 Secondary Standards Check Date (in house) Scheduled Check Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Oct-20) In house check: Oct-22 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-20) In house check: Oct-22 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-20) In house check: Oct-22 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-20) In house check: Oct-22 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-20) In house check: Oct-21 Name Function Calibrated by: Michael Weber Laboratory Technician Approved by: Katja Pokovic Technical Manager Issued: February 23, 2021 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D3500V2-1040\_Feb21

Page 1 of 6

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





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 N/A sensitivity in TSL / NORM x,y,z

not applicable or not measured

### Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D3500V2-1040\_Feb21

Page 2 of 6

### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3500 MHz ± 1 MHz	

Head TSL parameters
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.1 ± 6 %	2.93 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.67 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	66.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.9 W/kg ± 19.5 % (k=2)

Certificate No: D3500V2-1040\_Feb21

Page 3 of 6

### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω - 5.2 jΩ		
Return Loss	- 23.6 dB		

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.140 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
licate No: D3500V2-1040 Feb21	Page 4 of 6	

#### DASY5 Validation Report for Head TSL

Date: 17.02.2021

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1040

Communication System: UID 0 - CW; Frequency: 3500 MHz

Medium parameters used: f = 3500 MHz;  $\sigma = 2.93$  S/m;  $\varepsilon_r = 37.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN3503; ConvF(7.91, 7.91, 7.91) @ 3500 MHz; Calibrated: 30.12.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

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

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

## Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3500MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.60 V/m; Power Drift = 0.03 dB

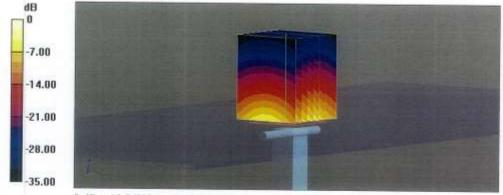
Peak SAR (extrapolated) = 18.1 W/kg

SAR(1 g) = 6.67 W/kg; SAR(10 g) = 2.5 W/kg

Smallest distance from peaks to all points 3 dB below = 8.6 mm

Ratio of SAR at M2 to SAR at M1 = 75.1%

Maximum value of SAR (measured) = 12.7 W/kg

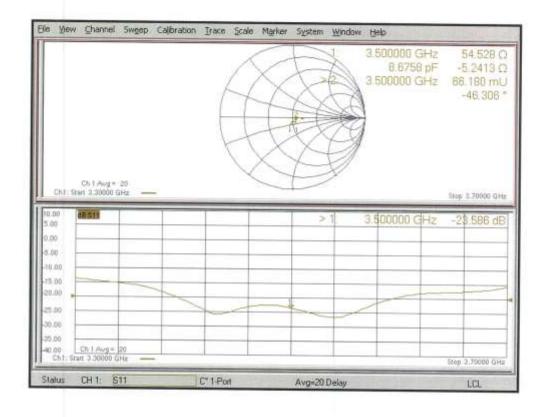


0 dB = 12.7 W/kg = 11.04 dBW/kg

Certificate No: D3500V2-1040\_Feb21

Page 5 of 6

### Impedance Measurement Plot for Head TSL



Certificate No: D3500V2-1040\_Feb21

Page 6 of 6

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





Schweizerischer Kalibrierdienst 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 Accreditation No.: SCS 0108

Multilateral Agreement for the recognition of calibration certificates

Client HCT (Dymstec) Certificate No: D3700V2-1066\_Nov20 CALIBRATION CERTIFICATE Object D3700V2 - SN:1066 世级 160 / 対分と SW 1 1200 2010 2020/ Calibration procedure(s) QA CAL-22.v5 Calibration Procedure for SAR Validation Sources between 3-10 GHz Calibration date: November 19, 2020 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards Cal Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 01-Apr-20 (No. 217-03100/03101) Apr-21 Power sensor NRP-Z91 SN: 103244 01-Apr-20 (No. 217-03100) Apr-21 Power sensor NRP-Z91 SN: 103245 01-Apr-20 (No. 217-03101) Apr-21 Reference 20 dB Attenuator SN: BH9394 (20k) 31-Mar-20 (No. 217-03106) Apr-21 Type-N mismatch combination SN: 310982 / 06327 31-Mar-20 (No. 217-03104) Apr-21 Reference Probe EX3DV4 SN: 3503 31-Dec-19 (No. EX3-3503\_Dec19) Dec-20 SN: 601 02-Nov-20 (No. DAE4-601\_Nov20) Nov-21 Secondary Standards Check Date (in house) Scheduled Check Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Oct-20) In house check: Oct-22 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-20) In house check: Oct-22 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-20) In house check: Oct-22 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-20) In house check: Oct-22 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-20) In house check: Oct-21 Function Calibrated by: Michael Weber Laboratory Technician Approved by: Katja Pokovic Technical Manager Issued: November 19, 2020 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D3700V2-1066\_Nov20

Page 1 of 6

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





Schweizerischer Kalibrierdienst Service sulsse 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 N/A sensitivity in TSL / NORM x,y,z

not applicable or not measured

### Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- EC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- 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: D3700V2-1066\_Nov20

Page 2 of 6

#### Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4  mm, dz = 1.4  mm	Graded Ratio = 1.4 (Z direction)
Frequency	3700 MHz ± 1 MHz	

## **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.7	3.12 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.4 ± 6 %	3.09 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-4	

### SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.61 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	66.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 19.5 % (k=2)

## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.0 Ω + 0.4 jΩ		
Return Loss	- 33.7 dB		

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.137 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

Certificate No: D3700V2-1066\_Nov20

Page 4 of 6

### DASY5 Validation Report for Head TSL

Date: 19.11.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1066

Communication System: UID 0 - CW; Frequency: 3700 MHz

Medium parameters used: f = 3700 MHz;  $\sigma = 3.09$  S/m;  $\epsilon_r = 38.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN3503; ConvF(7.73, 7.73, 7.73) @ 3700 MHz; Calibrated: 31.12.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

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

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

### Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3700MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.37 V/m; Power Drift = -0.01 dB

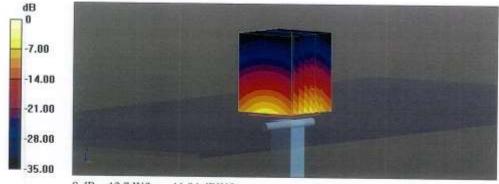
Peak SAR (extrapolated) = 18.6 W/kg

SAR(1 g) = 6.61 W/kg; SAR(10 g) = 2.39 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 74.2%

Maximum value of SAR (measured) = 12.7 W/kg

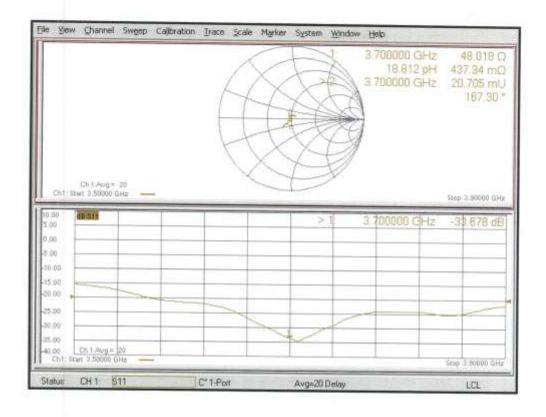


0 dB = 12.7 W/kg = 11.04 dBW/kg

Certificate No: D3700V2-1066\_Nov20

Page 5 of 6

### Impedance Measurement Plot for Head TSL



Certificate No: D3700V2-1066\_Nov20

Page 6 of 6

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





Schweizerischer Kalibrierdiens 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

Client

HCT (Dymstec)

Certificate No: D3900V2-1019 May20

Diject	D3900V2 - SN:10	019	
alibration procedure(s)	QA CAL-22.v4 Calibration Proce	dure for SAR Validation Sources	between 3-6 GHz
alibration date:	May 22, 2020	41/39 SW / 2/4	10 575 1 247129 16 2020 1 8 16
		onal standards, which realize the physical un	
ne mounte emante and the uncer	отприя так согнавное р	robability are given on the following pages an	ware part or one certificate,
Il calibrations have been conduct	ed in the closed laborator	y facility; environment temperature $(22 \pm 3)^{\circ}$	C and humidity < 70%.
Calibration Equipment used (M&T)	E critical for calibration)		
rimary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
ower sensor NRP-Z91	SN; 103244	01-Apr-20 (No. 217-03100)	Apr-21
ower sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
eference 20 dB Attenuator	SN; BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
ype-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
leference Probe EX3DV4	SN: 3503	31-Dec-19 (No. EX3-3503_Dec19)	Dec-20
AE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20
	1	Check Date (in house)	Scheduled Check
Secondary Standards	ID#	Citatic Carlo (a) House)	
Secondary Standards Power meter E4419B	ID # SN: GB39512475	30-Oct-14 (in house check Feb-19)	
	THE RESIDENCE OF THE PARTY OF T		In house check: Oct-20
ower meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20 In house check: Oct-20
ower meter E44198 ower sensor HP 8481A	SN: GB39512475 SN: US37292783	30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18)	In house check: Oct-20 In house check: Oct-20 In house check; Oct-20 In house check: Oct-20
Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	SN: GB39512475 SN: US37292783 SN: MY41092317	30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	In house check: Oct-20 In house check: Oct-20 In house check; Oct-20 In house check: Oct-20
Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972	30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 letwork Analyzer Agilent E8358A	SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)	In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)	In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20

Certificate No: D3900V2-1019\_May20

Page 1 of 6

S

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





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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS).

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

#### Glossary:

TSL tissue simulating liquid

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

### Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated,
- · Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna
- 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: D3900V2-1019 May20

Page 2 of 6

#### Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom 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	3900 MHz ± 1 MHz	

### Head TSL parameters at 3900 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.5	3,32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.2 ± 6 %	3.22 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	1444

### SAR result with Head TSL at 3900 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	70.7 W/kg ± 19.9 % (k=2)

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

Certificate No: D3900V2-1019\_May20

Page 3 of 6

### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL at 3900 MHz

Impedance, transformed to feed point	49.7 Ω - 6.9 jΩ	
Return Loss	- 23.2 dB	

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.102 ns

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

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

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

#### Additional EUT Data

Manufactured by	SPEAG

Certificate No: D3900V2-1019\_May20

Page 4 of 6

#### **DASY5 Validation Report for Head TSL**

Date: 22.05.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN:1019

Communication System: UID 0 - CW; Frequency: 3900 MHz

Medium parameters used: f = 3900 MHz;  $\sigma = 3.22 \text{ S/m}$ ;  $\varepsilon_r = 37.2$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN3503; ConvF(7.39, 7.39, 7.39) @ 3900 MHz; Calibrated: 31.12.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 27.12.2019

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

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

#### Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3900MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.45 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 20.4 W/kg

SAR(1 g) = 7.05 W/kg; SAR(10 g) = 2.44 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 73.3%

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



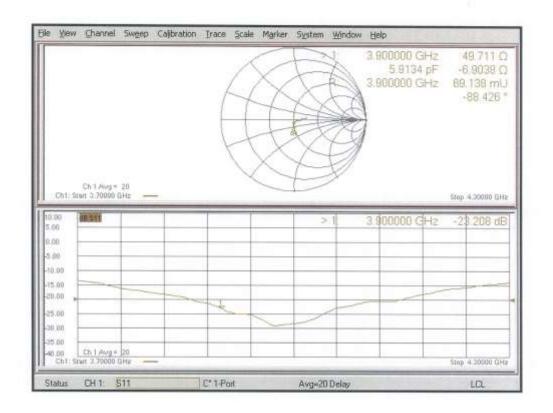
0 dB = 13.9 W/kg = 11.43 dBW/kg

Certificate No: D3900V2-1019\_May20

Page 5 of 6

### FCC ID: A3LSMG990U

### Impedance Measurement Plot for Head TSL



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





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

Client HCT (Dymstec)

Certificate No: D5GHzV2-1253\_Aug20

CALIBRATION CE	RTIFICATE	경	타 당 자	확인자
			116	in
Object	D5GHzV2 - SN:12	253 제	0	6 1419.18
roless.	EN SHIP OF THE PARTY OF	411/99	5w 1 45873	The state of the s
		및 파	2020 / 10,6	2020 / 10.6
	QA CAL-22.v5 Calibration Proces	dure for SAR Valid	lation Sources b	etween 3-10 GHz
Calibration date:	August 31, 2020			
All calibrations have been conducte		y facility: environment ter	nperature (22 ± 3)°C i	and humidity < 70%.
Primary Standards	ID#	Cal Date (Certificate No.)		Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)		Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)		Apr-21
	SN: 103245	01-Apr-20 (No. 217-03101)		Apr-21
Power sensor NRP-Z91	GIN. 100640			
	SN: BH9394 (20k)	31-Mar-20 (No. 217-03	106)	Apr-21
Reference 20 dB Attenuator				Apr-21 Apr-21
Reference 20 dB Attenuator Type-N mismatch combination	SN: BH9394 (20k)	31-Mar-20 (No. 217-03	(104)	
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: BH9394 (20k) SN: 310962 / 06327	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03	(104) 503_Dec19)	Apr-21
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: BH9394 (20k) SN: 310962 / 06327 SN: 3503	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3	5104) 503_Dec19) 601_Dec19)	Apr-21 Dec-20
Reterence 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: BH9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4-	5104) 503_Dec19) 601_Dec19)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Reterence 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198	SN: BH9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4- Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of	503_Dec19) 601_Dec19) neck Feb-19) neck Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A	SN: BH8394 (20K) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4- Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of	104) 503_Dec19) 601_Dec19) neck Feb-19) neck Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-08	SN: BH8394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38612475 SN: US37292783 SN: MY41092317 SN: 100972	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4- Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of 15-Jun-15 (in house of	9104) 503_Dec19) 601_Dec19) neck Feb-19) neck Oct-18) heck Oct-18)	Apr-21 Disc-20 Dec-20 Scheduled Check In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A RF generator R&S S&IT-08	SN: BH8394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783 SN: MY41092317	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4- Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of	9104) 503_Dec19) 601_Dec19) neck Feb-19) neck Oct-18) heck Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: BH8394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38612475 SN: US37292783 SN: MY41092317 SN: 100972	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4- Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of 15-Jun-15 (in house of	9104) 503_Dec19) 601_Dec19) neck Feb-19) neck Oct-18) heck Oct-18)	Apr-21 Disc-20 Dec-20 Scheduled Check In house check: Oct-20
Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08	SN: BH8394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4- Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of 07-Oct-15 (in house of 15-Jun-15 (in house of 31-Mar-14 (in house of	9104) 503_Dec19) 601_Dec19) neck Feb-19) neck Oct-18) heck Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Reference 20 dB Attanuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E44198 Power sensor HP 8481A RF generator H8 S SMT-08 Network Analyzer Agilent E8358A	SN: BH8394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4- Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of 07-Oct-15 (in house of 15-Jun-15 (in house of 31-Mar-14 (in house of	st04) 503_Dec19) 601_Dec19) heck Feb-19) heck Oct-18) heck Oct-18) heck Oct-18) heck Oct-19)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20

Certificate No: D5GHzV2-1253\_Aug20

Page 1 of 8

#### Calibration Laboratory of

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





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

Accreditation No.: SCS 0108

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

#### Glossary:

TSL tissue simulating liquid

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

#### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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: D5GHzV2-1253\_Aug20

Page 2 of 8

#### Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 10.0 mm, dz = 10.0 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

### Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.48 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	A

#### SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

### 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	34.2 ± 6 %	4.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		_

### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1253\_Aug20

# Head TSL parameters at 5750 MHz The following parameters and calculations were applied.

14-14-14-14-14-14-14-14-14-14-14-14-14-1	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	4.98 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm <sup>2</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.2 Ω - 4.4 jΩ
Return Loss	- 27.1 dB

#### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	52.0 Ω + 1.8  Ω
Return Loss	- 31.6 dB

#### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	55.8 Ω + 2.3 jΩ
Return Loss	- 24.6 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 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

	The state of the s
Manufactured by	SPEAG

Certificate No: D5GHzV2-1253\_Aug20

Page 5 of 8

### **DASY5 Validation Report for Head TSL**

Date: 31.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1253

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Medium parameters used: f = 5250 MHz;  $\sigma = 4.48$  S/m;  $\varepsilon_r = 34.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>.

Medium parameters used: f = 5600 MHz;  $\sigma = 4.83 \text{ S/m}$ ;  $\epsilon_r = 34.2$ ;  $\rho = 1000 \text{ kg/m}^3$ .

Medium parameters used: f = 5750 MHz;  $\sigma = 4.98 \text{ S/m}$ ;  $\epsilon_r = 34.0$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz,
   ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

#### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm

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

Reference Value = 77.63 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.31 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 69.8%

Maximum value of SAR (measured) = 18.3 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 = 77.49 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.3 W/kg

SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.38 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 66.9%

Maximum value of SAR (measured) = 19.7 W/kg

### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm

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

Reference Value = 75.13 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 31.8 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.30 W/kg

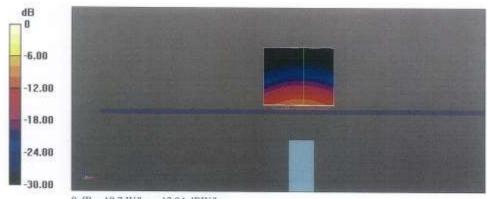
Smallest distance from peaks to all points 3 dB below = 7.4 mm

Ratio of SAR at M2 to SAR at M1 = 65.3%

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

Certificate No: D5GHzV2-1253\_Aug20

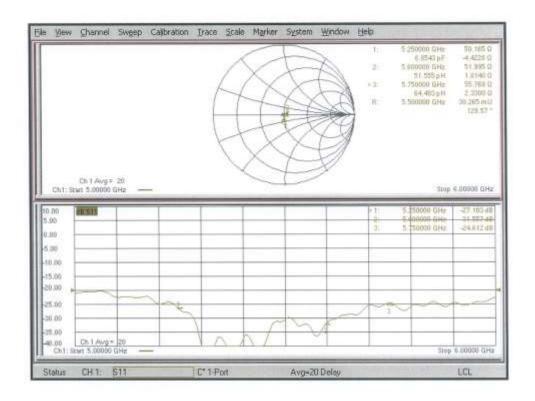
Page 6 of 8



Certificate No: D5GHzV2-1253\_Aug20

Page 7 of 8

### Impedance Measurement Plot for Head TSL



Certificate No: D5GHzV2-1253\_Aug20