

# Appendix G. – Dipole Calibration Data



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





S Schweizerischer Kalibrierdianst
Service suisse d'étaionnage
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

Ctlent

HCT (Dymstec)

Certificate No: D750V3-1014\_Jun21

	ERTIFICATE	-21	담당자	확인자
Object	D750V3 - SN:101	14 재	DL 642/4 2011 06:10	की अनुम् राम १६ १०
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validat		
albration date:	June 01, 2021			
The measurements and the uncert  All calibrations have been conducts  Calibration Equipment used (M&TE	ed in the closed laborator	8 8	303	
Primary Standards	ID#	Cal Date (Certificate No.)		Scheduled Calibration
ower meter NRP ower sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245	09-Apr-21 (No. 217-03291 09-Apr-21 (No. 217-03291 09-Apr-21 (No. 217-03292 09-Apr-21 (No. 217-03343	9	Apr-22 Apr-22 Apr-22 Apr-22
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	09-Apr-21 (No. 217-03344 28-Dec-20 (No. EX3-7349 02-Nov-20 (No. DAE4-601	_Dec20)	Apr-22 Dec-21 Nov-21
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 310982 / 06327 SN: 7349	09-Apr-21 (No. 217-03344 28-Dec-20 (No. EX3-7349	_Dec20)	Dec-21
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-06	SN: 310982 / 06327 SN: 7349 SN: 601	08-Apr-21 (No. 217-03344 28-Dec-20 (No. EX3-7349 02-Nov-20 (No. DAE4-601	L_Dec20) L_Nov20)  k Oct-20) k Oct-20) k Oct-20) k Oct-20)	Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
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-06	SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512476 SN: US37292783 SN: MY41092317 SN: 100972	08-Apr-21 (No. 217-03344 28-Dec-20 (No. EX3-7349 02-Nov-20 (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	L_Dec20) L_Nov20)  k Oct-20) k Oct-20) k Oct-20) k Oct-20)	Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477	09-Apr-21 (No. 217-03344 28-Dec-20 (No. EX3-7349 02-Nov-20 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house checl 07-Oct-15 (in house checl 15-Jun-15 (in house checl 31-Mar-14 (in house checl	_Dec20) t_Nov20)  k Oct-20) k Oct-20) k Oct-20) k Oct-20) k Oct-20)	Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
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: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US41090477 Name	09-Apr-21 (No. 217-03344 28-Dec-20 (No. EX3-7349 02-Nov-20 (No. DAE4-601 Check Date (in house) 30-Oct-14 (in house checi 07-Oct-15 (in house checi 15-Jun-15 (in house checi 15-Jun-15 (in house checi 31-Mar-14 (in house checi	_Dec20) t_Nov20) k Oct-20) k Oct-20) k Oct-20) k Oct-20) k Oct-20)	Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21

Certificate No: D750V3-1014\_Jun21

Page 1 of 6



Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 6004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst
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
- 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: D750V3-1014\_Jun21

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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0,89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.7 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		S = 100 S

## SAR result with Head TSL

SAR sveraged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.55 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	1.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.57 W/kg ± 16.5 % (k=2)

Certificate No: D750V3-1014\_Jun21

Page 3 of 6



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

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 $\Omega$ + 3,3 $\Omega$	
Return Loss	- 26.3 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	.039 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: D750V3-1014\_Jun21

Page 4 of 6



## DASY5 Validation Report for Head TSL

Date: 01.06,2021

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;  $\sigma = 0.91 \text{ S/m}$ ;  $\varepsilon_r = 42.7$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- 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 = 60.13 V/m; Power Drift = -0.01 dB

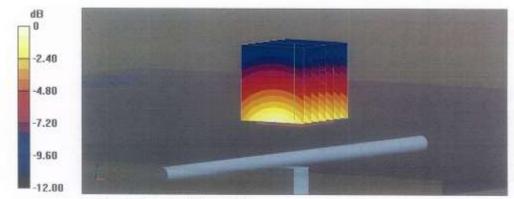
Peak SAR (extrapolated) = 3.32 W/kg

SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.41 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 65.2%

Maximum value of SAR (measured) = 2.92 W/kg



0 dB = 2.92 W/kg = 4.66 dBW/kg

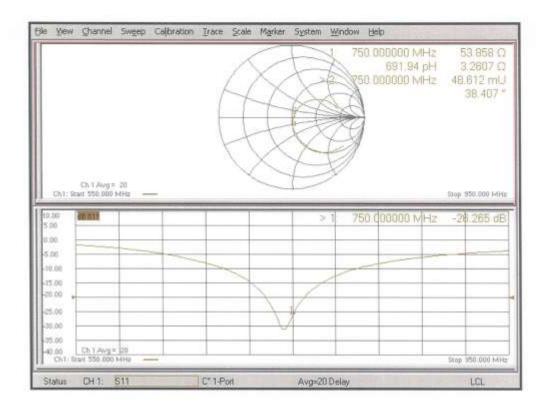
Certificate No: D750V3-1014\_Jun21

Page 5 of 6



Report No: HCT-SR-2107-FC004

## Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1014\_Jun21

Page 6 of 6



Report No: HCT-SR-2107-FC004

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





Schweizerischer Kalibrierdienst 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

Certificate No: D835V2-4d266 Aug20

CALIBRATION C	ERTIFICATE	검 보 방	자 의 의 자
Object	D835V2 - SN:4d	세취생명 [W / W	445 43 / 4734
Calibration procedure(s)	OA CAL-05.v11 Calibration Proce	및 제 제3 / ( edure for SAR Validation Source	ces between 0.7-3 GHz
Calibration date:	August 27, 2020		
The measurements and the uncert	ainties with confidence p	onal standards, which realize the physics robability are given on the following page	s and are part of the certificate.
		ry facility: environment temperature (22 ±	3/°C and humidity < 70%.
Calibration Equipment used (M&TE	7		
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Name and Advantage of the Control of			
	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 Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 103244 SN: 103245	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101)	5555,0000111
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103244 SN: 103245 SN: BH9394 (20k)	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03105)	Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104)	Apr-21 Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20)	Apr-21 Apr-21 Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104)	Apr-21 Apr-21 Apr-21 Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Alternator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Alternator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 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)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Alternator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power mater E4419B Fower sensor HP 8481A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 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)	Agr-21 Agr-21 Agr-21 Agr-21 Jun-21 Dec-20 Scheduled Check
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power mater E4419B Power sensor HP 8481A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 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-16) 07-Oct-15 (in house check Oct-16)	Agr-21 Agr-21 Agr-21 Agr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power moter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 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-16) 07-Oct-15 (in house check Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-21 In house check: Oct-21 In house check: Oct-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power moter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 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-16) 07-Oct-15 (in house check Oct-16)	Agr-21 Agr-21 Agr-21 Agr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-26 In house check: Oct-26
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agitent E83S8A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 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-16) 07-Oct-15 (in house check Oct-18)	Agr-21 Agr-21 Agr-21 Agr-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
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Alternator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power moter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 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-16) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)	Agr-21 Agr-21 Agr-21 Agr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Alternator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E83S8A Calibrated by:	SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 SN: 100972 SN: US41080477 Name Jeffrey Katzman	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 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-16) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-19) Function	Agr-21 Agr-21 Agr-21 Agr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Alternator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Fower sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E83S8A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 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-16) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-19) Function	Apr.21 Apr.21 Apr.21 Apr.21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2

Certificate No: D835V2-4d266\_Aug20

Page 1 of 7



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





S Schweizerischer Kalibrierdienst
C Service sulsse 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:

- 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		

## 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



Report No: HCT-SR-2107-FC004

## **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

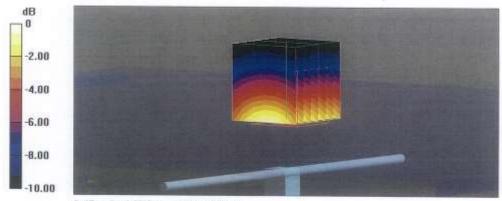
Peak SAR (extrapolated) = 3.57 W/kg

## 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

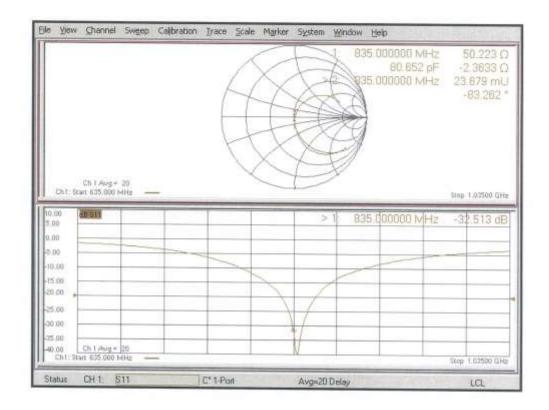
Certificate No: D835V2-4d266\_Aug20

Page 5 of 7



Report No: HCT-SR-2107-FC004

## Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d266\_Aug20

Page 6 of 7



Report No: HCT-SR-2107-FC004

## 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 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	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

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





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

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

TEIDIO TION C	ERTIFICATI	E 결	75	의 인 자
Object	D1800V2 - SN:2	d007 기위기기 경 자	54 14489 2020 118.6	2020 1 10 E
Calibration procedure(s)	QA CAL-05,v11 Calibration Proce	edure for SAR Val	idation Sources	between 0.7-3 GHz
Calibration date:	August 26, 2020	PECCHI III		
This calibration certificate docume The measurements and the uncer All calibrations have been conduct Calibration Equipment used (M&T)	tainties with confidence parted in the closed laborator E critical for calibration)	robability are given on th	e following pages and	are part of the certificate.
Primary Standards	ID#	Cal Date (Certificate)	No.)	Scheduled Calibration
ower meter NRP	SN: 104778	01-Apr-20 (No. 217-0	3100/03101)	Apr-21
ower sensor NRP-291	SN: 103244	01-Apr-20 (No. 217-0	3100)	Apr-21
ower sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-0	3101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-0	3106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-0	3104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-)	7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4	I-601_Dec19)	Dec-20
Secondary Standards	ID#	Check Date (in house	)	Scheduled Check
ower meter E4419B	SN: GB39512475	30-Oct-14 (In house of	heck Feb-19)	In house check: Oct-20
ower sensor HP 8481A	5N: US37292783	07-Oct-15 (in house of	heck Oct-18)	In house check: Oct-20
ower sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house of	heck Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house o	thack Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house of	check Oct-19)	In house check: Oct-20
	Name	Function		Signature
Calibrated by:	Leif Klysner	NAME OF TAXABLE PARTY.	y Technician	19.0000
		35.00		Self High
Approved by:	Katja Pokovic	Technical	Manager	later
	THE PARTY OF THE P	T WARRINGS	mendyor	
***********				meng

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
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 r

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: 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 cm <sup>3</sup> (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

Page 3 of 6



## 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
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;  $\sigma = 1.38$  S/m;  $\epsilon_r = 40.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY52 Configuration:

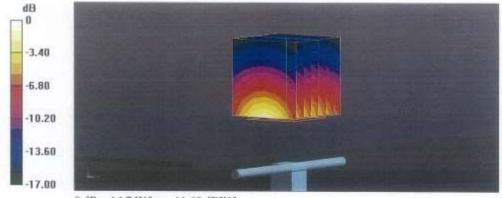
Probe: EX3DV4 - SN7349; ConvF(8.38, 8.38, 8.38) @ 1800 MHz; Calibrated: 29.06,2020

- 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

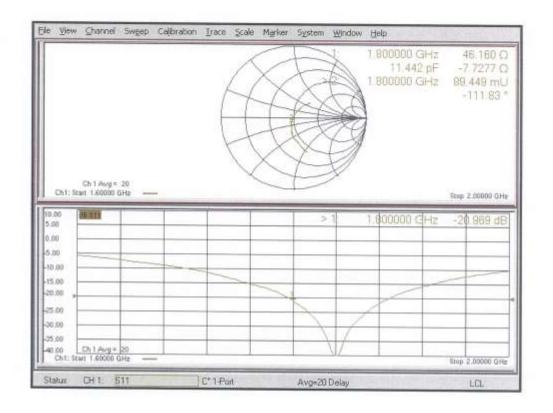
Certificate No: D1800V2-2d007\_Aug20

Page 5 of 6



Report No: HCT-SR-2107-FC004

## Impedance Measurement Plot for Head TSL



Certificate No: D1800V2-2d007\_Aug20

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

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

	HCT (Dymstec)		Certificate No: D1900V2-5d032_Ja	
CALIBRATION C	ERTIFICATE	71	담당자	확인자
Object	D1900V2 - SN:56	해32 재	DE VIX 3	C1484
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	edure for SAR Valida		
Calibration date:	January 28, 2021			
This calibration certificate docume The measurements and the uncert All calibrations have been conduct	ainties with confidence p	robability are given on the fo	ollowing pages and ar	re part of the certificate.
Celibration Equipment used (M&TE	critical for calibration)			
Primary Standards	ID #	Cal Date (Certificate No.)		Scheduled Calibration
the same of the sa	ID# SN: 104778	Cal Date (Certificate No.) 01-Apr-20 (No. 217-0310	Access to the latest and the latest	Scheduled Calibration Apr-21
ower meter NRP	- Contract Contract		0/03101)	
Power meter NRP Power sensor NRP-Z91	SN: 104778	01-Apr-20 (No. 217-0310	0/03101) 0)	Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244	01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310	0/03101) 0) 1)	Apr-21 Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Altenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	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	0/03101) 0) 1) 16) 44)	Apr-21 Apr-21 Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: BH9304 (20k) SN: 310982 / 06327 SN: 7349	01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 31-Mar-20 (No. 217-0310	0/03101) 0) 1) 16) 44)	Apr-21 Apr-21 Apr-21 Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Altenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	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	0/03101) 0) 11) 16) 14) 9_Dec20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Altenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: BH9304 (20k) SN: 310982 / 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)	0/03101) 0) 11) 16) 14) 9_Dec20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 104778 SN: 103244 SN: 103245 SN: BH9304 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475	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. EX3-7340 02-Nov-20 (No. DAE4-60 Check Date (in house)	0/03101) 0) 1) 6) 6) 4) 9_Dec20) 1_Nov20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Pype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783	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 Check Date (in house) 30-Oct-14 (in house chec	0/03101) 0) 1) 6) 4) 9 Dec20) 1 Nov20) k Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check In house check: Oct-2
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	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 Check Date (in house) 30-Oct-14 (in house chec 07-Oct-15 (in house chec	0:03101) 0) 1) 6) 4) 9 Dec20) 1 Nov20) k Oct-20) k Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9304 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB99512475 SN: US37292783 SN: MY41092317 SN: 100972	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 Check Date (in house) 30-Cct-14 (in house chec 07-Oct-15 (in house chec 15-Jun-15 (in house chec	0.03101) 0) 11) 16) 14) 9_Dec20) 1_Nov20)  k Oct-20) k Oct-20) c Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check in house check: Oct-2: in house check: Oct-2: in house check: Oct-2: in house check: Oct-2:
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	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 Check Date (in house) 30-Oct-14 (in house chec 07-Oct-15 (in house chec	0.03101) 0) 11) 16) 14) 9_Dec20) 1_Nov20)  k Oct-20) k Oct-20) c Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Altenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E6358A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	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 Check Date (in house) 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	0/03101) 0) 11) 16) 14) 9_Dec20) 1_Nov20)  k Oct-20) k Oct-20) k Oct-20) ck Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Altenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	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. EXG-734) 02-Nov-20 (No. DAE4-60 Check Date (in house) 30-Oct-14 (in house chec 07-Oct-15 (in house chec 15-Jun-15 (in house chec 31-Mar-14 (in house chec	0/03101) 0) 11) 16) 14) 9_Dec20) 1_Nov20)  k Oct-20) k Oct-20) k Oct-20) ck Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Altenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E6358A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39612475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	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 Check Date (in house) 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	0.03101) 0) 1) 6) 4) 9 Dec20) 1, Nov20)  k Oct-20) k Oct-20) c Oct-20) c Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check In house check: Oct-2:

Certificate No: D1900V2-5d032\_Jan21

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
- 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

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 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	9.89 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 Ω + 7.4 jΩ	
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



FCC ID: A3LSMG715U1 Report

Report No: HCT-SR-2107-FC004

## **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;  $\varepsilon_t = 41.2$ ;  $\rho = 1000$  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:

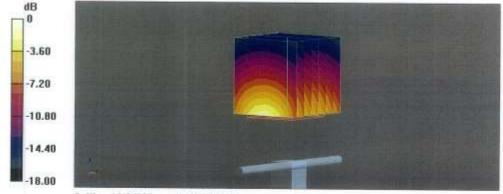
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 109.8 V/m; Power Drift = -0.02 dB

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

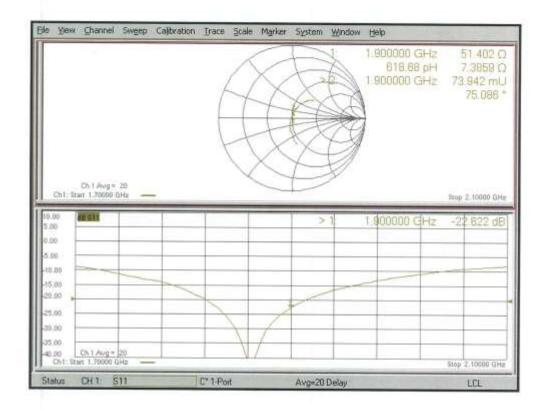
Certificate No: D1900V2-5d032\_Jan21

Page 5 of 6



Report No: HCT-SR-2107-FC004

## Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d032\_Jan21

Page 6 of 6



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





S Schweizerischer Kalibrierdienst
C Service sulsee 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: D2300V2-1010 Aug20

			BOOKEN SECTION OF THE PROPERTY	
CALIBRATION C	ERTIFICATI	E 결	BBA	의의자
7050C 20		제	16	7
Object	D2300V2 - SN:1	010	5W / 944	कि । अरम
		11 2	2020 / 106	70701126
Calibration procedure(s)	QA CAL-05.v11	THE RESERVE OF THE PARTY OF THE		
		edure for SAR Valid	ation Sources be	etween 0.7-3 GHz
Calibration date:	August 26, 2020			
Describino i delle,	nugusi 20, 2020			
	Control (September 2015)			
This calibration certificate documer	its the traceability to nati	onal standards, which resit	ze the physical units o	f measurements (SI).
The measurements and the uncert	ainties with confidence p	robability are given on the I	following pages and ar	e part of the certificate.
All and bentines have been and a	area and a second			
All calibrations have been conducts	ed in the closed laborator	y facility: environment tem	perature (22 ± 3)°C an	d humidity < 70%.
Calibration Equipment used (M&TE	critical for estimations			
outer attorn Equipment Land (MB LE	Gribal for Calibration)			
Primary Standards	ID#	Cal Date (Certificate No	1.3	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-031		Apr-21
awer sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-031	00)	Apr-21
ower sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-031	01)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-031	106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-031	(04)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-734	(9_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-6	01_Dec19}	Dec-20
Secondary Standards	ID#	Check Date (in house)		Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house che	ick Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house che		In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house che		In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house che		In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house che		in house check: Oct-20
	Name	Function		Circollus
Calibrated by:	Lorf Klysner		Tanhalana	Signature
	EAST TSUSINEE	Laboratory	econician	Seef Illgen
Approved by:	Maria Delimita	+000,000	Dr. 1900	
CHARLEST STATE STA	Katja Pokovic	Technical M	tanager	00111
				A COLO
				acres .

Certificate No: D2300V2-1010\_Aug20

Page 1 of 6

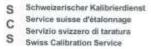


# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland







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: 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
22.0 °C	39.5	1.67 mho/m
(22.0 ± 0.2) °C	39.4 ± 6 %	1.68 mho/m ± 6 %
< 0.5 °C	-	<u> 1111</u>
	22.0 °C (22.0 ± 0.2) °C	22.0 °C 39.5 (22.0 ± 0.2) °C 39.4 ± 6 %

## 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 cm <sup>3</sup> (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)

Certificate No: D2300V2-1010\_Aug20

Page 3 of 6



## 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

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

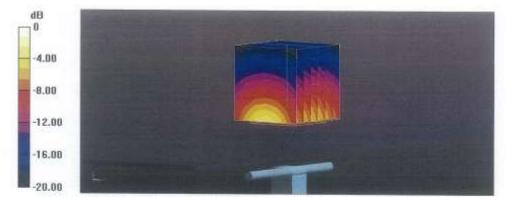
Reference Value = 114.4 V/m; Power Drift = 0.00 dB

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



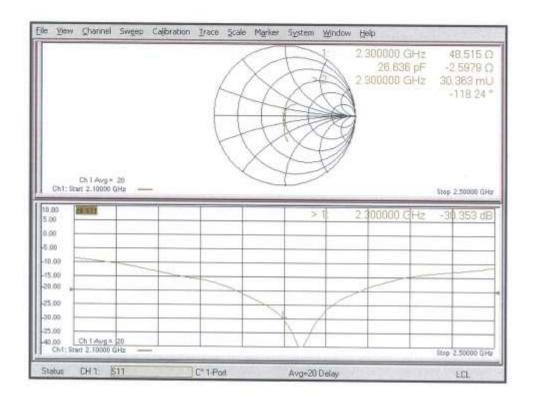
0 dB = 19.2 W/kg = 12.83 dBW/kg

Certificate No: D2300V2-1010\_Aug20

Page 5 of 6



## Impedance Measurement Plot for Head TSL



Certificate No: D2300V2-1010\_Aug20

Page 6 of 6



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





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

lient HCT (Dymstec) Certificate No. D2450V2-1049\_Aug20

ALIDKA HON C	ERTIFICATE	E 결 보 1 기 기 기 기 기 기 기 기 기 기 기 기 기 기 기 기 기 기	화인자
		제 /6	1hn
bject	D2450V2 - SN:10	149	
		411/201 3 W / OLAS	
		9 4 010 10.6	1010 / 10.6
alibration procedure(s)	QA CAL-05.v11		
	Calibration Proce	dure for SAR Validation Sources	between 0.7-3 GHz
	SHIPP OF SHIP		
Manager Manager			
alibration date:	August 26, 2020		
		onal standards, which realize the physical unit	the state of the second control of the secon
he measurements and the uncerta	ainties with confidence pr	robability are given on the following pages and	i are part of the certificate.
I calibrations have been conducte	ed in the closed laborator	ry facility: environment temperature (22 ± 3)°C	and humidity < 70%.
			OCTOR CONTINUES OF STREET
alibration Equipment used (M&TE	critical for calibration)		
and the second section of the second	ormon for manacereary		
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-29 (No. 217-03101)	Apr-21
eference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
ype-N mismatch combination			
ype-N mismatch combination reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349 Jun20)	Jun-21
	SN: 7349 SN: 601	29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19)	Jun-21 Dec-20
reference Probe EX3DV4 AE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20
eference Probe EX3DV4 AE4 econdary Standards	SN: 601	27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house)	Dec-20 Scheduled Check
eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B	SN: 601 ID W SN: GB39512475	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)	Dec-20 Scheduled Check In house check: Oct-20
econdary Standards ower meter E4419B ower sensor HP 8481A	SN: 601 ID # SN: GB39512475 SN: US37292783	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  97-Oct-15 (in house check Oct-18)	Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A	SN: 601 ID W SN: GB39512475 SN: US37292783 SN: MY41092317	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)	Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
econdary Standards econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)	Dec-20  Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
econdary Standards ower meter E4419B ower sensor HP 8481A	SN: 601 ID W SN: GB39512475 SN: US37292783 SN: MY41092317	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)	Dec-20  Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
econdary Standards econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	27-Dec-19 (No. DAE 4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-19)	Dec-20  Scheduled Check In house check: Oct-20
reference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 estwork Analyzar AgBant E8358A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-19)  Function	Dec-20  Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 etwork Analyzer Aglient E8358A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	27-Dec-19 (No. DAE 4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-19)	Dec-20  Scheduled Check In house check: Oct-20
eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 etwork Analyzer Aglient E8358A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-19)  Function	Dec-20  Scheduled Check In house check: Oct-20
reference Probe EX3DV4 AE4 econdary Standards ower meter E44198 ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 letwork Analyzer Agliant E8358A	SN: 601  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477  Name Loif-Klysnor	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)  Function  Eaboratory Technician	Dec-20  Scheduled Check In house check: Oct-20
reference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 estwork Analyzar AgBant E8358A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-19)  Function	Dec-20  Scheduled Check In house check: Oct-20
oference Probe EX3DV4 AE4 scondary Standards over meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 setwork Analyzer Agilent E8358A slibrated by:	SN: 601  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477  Name Loif-Klysnor	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)  Function  Eaboratory Technician	Dec-20  Scheduled Check In house check: Oct-20
oference Probe EX3DV4 AE4 econdary Standards ower meter E44198 ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 etwork Analyzer Aglient E8358A allibrated by:	SN: 601  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477  Name Loif-Klysnor	27-Dec-19 (No. DAE4-601_Dec19)  Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)  Function  Eaboratory Technician	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.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.84 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	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 cm <sup>3</sup> (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

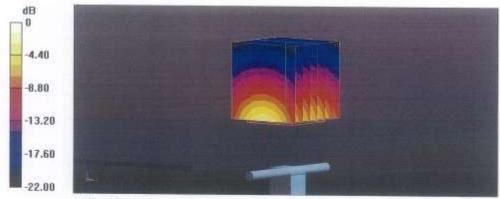
Peak SAR (extrapolated) = 25.5 W/kg

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

Partie of SAR at M2 to SAR at M1 = 51.28/

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

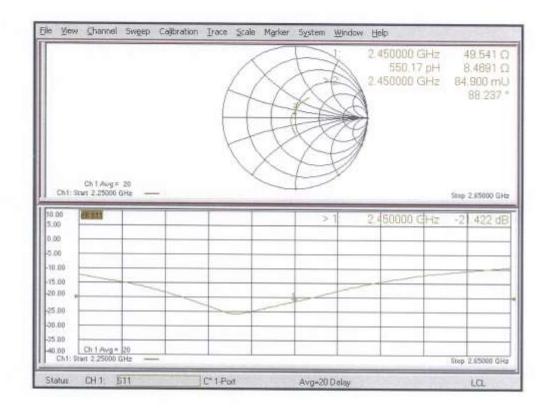
Certificate No: D2450V2-1049\_Aug20

Page 5 of 7



Report No: HCT-SR-2107-FC004

## Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-1049\_Aug20

Page 6 of 7



Report No: HCT-SR-2107-FC004

## 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)
STEWARD FOR A STATE OF THE STAT		
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	111 241

## 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 cm <sup>3</sup> (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	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	
Sear averaged over 10 cm. (10 g) of near 12F	CONCIDENT	

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





S Schweizerischer Kalibrierdienst
C Service sulisse 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

HCT (Dymstec) Certificate No: D2600V2-1015\_Aug20

AND THE PERSON NAMED IN	ERTIFICATI	图 图	및 및 자	파 인 자
194000		ws 20	76	hi
Object	D2600V2 - SN:10	110	4w / 91H	1
		9 A	20 20 1 10.6	200 106
Calibration procedure(s)	QA CAL-05.v11	- THE PROPERTY OF THE PARTY OF	20-5-1 10-6	100 10.0
	DOMESTIC OF THE OWNER OWNER OF THE OWNER	dure for SAR Valid	ation Sources	between 0.7-3 GHz
Calibration date:	August 26, 2020		Me C	
This calibration certificate documen	its the traceability to natio	onal standards, which reali	ze the physical unit	is of measurements (SI).
he measurements and the uncertainty	ainties with confidence pr	robability are given on the	following pages and	are part of the certificate.
Il calibrations have been conducte	of in the closed laborator	y facility: environment tem	perature (22 ± 3)°C	and humidity < 70%.
Calibration Equipment used (M&TE	critical for calibration)			
rimary Standards	ID#	Cal Data (Cadificate No	300	Selected Services
ower meter NRP	SN: 104778	Cal Date (Certificate No		Scheduled Calibration
DAARS VIIGHT LALAL.	214" ID4110	01-Apr-20 (No. 217-031	00/03101)	Apr-21
Ower server NDD 701	CAL 400044	the Assemble part one	0.00	
	SN: 103244	01-Apr-20 (No. 217-031		Apr-21
ower sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-031	01)	Apr-21 Apr-21
Fower sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103245 SN: BH9394 (20k)	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031	01)	Apr-21
Yower sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327	01-Apr-20 (No. 217-031	01)	Apr-21 Apr-21
Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103245 SN: BH9394 (20k)	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031	01) 106) 104)	Apr-21 Apr-21 Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031	01) 106) 104) 49_Jun20)	Apr-21 Apr-21 Apr-21 Apr-21
Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73	01) 106) 104) 49_Jun20)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 27-Dec-19 (No. DAE4-0	01) (06) (04) 49_Jun20) (01_Dec19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 27-Dec-19 (No. DAE4-6 Check Date (in house) 30-Oct-14 (in house che	01) (06) (04) 49_Jun20) (01_Dec19) ack Feb-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-21
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 27-Dec-19 (No. DAE4-6 Check Date (in house) 30-Oct-14 (in house che 07-Oct-15 (in house che	01) (06) (04) 49_Jun20) (01_Dec19) eck Feb-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2 In house check: Oct-2
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	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID# SN: GB39512475 SN: US37292783	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 27-Dec-19 (No. DAE4-0 Check Date (in house) 30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che	01) (06) (04) (9_Jun20) (01_Dec19) (cit Feb-19) (cit Oct-18) (cit Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2 In house check: Oct-2 In house check: Oct-2 In house check: Oct-2
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Fower meter E4419B Fower sensor HP 8481A Reference PR 8481A Reference Probe EX3DV4 Reference Probe EX3DV4 Reference Probe EX3DV4 Reference PROBE Refer	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 801 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 27-Dec-19 (No. DAE4-6 Check Date (in house) 30-Oct-14 (in house che 07-Oct-15 (in house che	01) 106) 104) 49_Jun20) 101_Dec19) 101_Dec19) 102_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 104_Feb-19) 105_Feb-19) 106_Feb-19) 107_Feb-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2 In house check: Oct-2
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	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 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	01) 106) 104) 49_Jun20) 101_Dec19) 101_Dec19) 102_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 103_Feb-19) 104_Feb-19) 105_Feb-19) 106_Feb-19) 107_Feb-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 JAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 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	01) 106) 104) 49_Jun20) 101_Dec19) 104 Feb-19) 105 Oct-18) 105 Oct-18) 106 Oct-18) 106 Oct-18) 107 Oct-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2
Reference 20 dB Attenuator ype-N mismatch combination teference Probe EX3DV4 IAE4 Secondary Standards Power meter E4419B Fower sensor HP 8481A Fower sensor HP 8481A UF generator R&S SMT-06 Retwork Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 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	01) 106) 104) 49_Jun20) 101_Dec19) 104 Feb-19) 105 Oct-18) 105 Oct-18) 106 Oct-18) 106 Oct-18) 107 Oct-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2
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	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 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	01) 106) 104) 49_Jun20) 101_Dec19) 104 Feb-19) 105 Oct-18) 105 Oct-18) 106 Oct-18) 106 Oct-18) 107 Oct-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 JAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 27-Dec-19 (No. DAE4-6 Oheck Date (in house) 30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che Function	01) 106) 104) 49_Jun20) 101_Dec19) 101_Dec19) 102k Feb-19) 102k Oct-18) 103k Oct-18) 103k Oct-18) 103k Oct-18) 103k Oct-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 JAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Retwork Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 SN: US41090477 Name Levi Klysner	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 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	01) 106) 104) 49_Jun20) 101_Dec19) 101_Dec19) 102k Feb-19) 102k Oct-18) 103k Oct-18) 103k Oct-18) 103k Oct-18) 103k Oct-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 JAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Retwork Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 SN: US41090477 Name Levi Klysner	01-Apr-20 (No. 217-031 31-Mar-20 (No. 217-031 31-Mar-20 (No. 217-031 29-Jun-20 (No. EX3-73- 27-Dec-19 (No. DAE4-6 Oheck Date (in house) 30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che Function	01) 106) 104) 49_Jun20) 101_Dec19) 101_Dec19) 102k Feb-19) 102k Oct-18) 103k Oct-18) 103k Oct-18) 103k Oct-18) 103k Oct-19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-2

Certificate No: D2600V2-1015\_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
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
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D2600V2-1015 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	the late.	_

#### 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

Page 3 of 6



### 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

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
Control of the Contro	

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

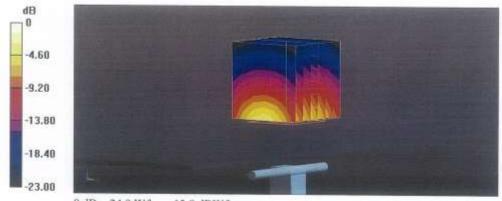
Peak SAR (extrapolated) = 28.6 W/kg

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

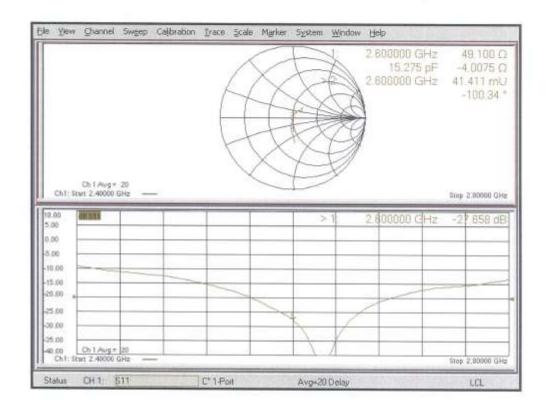
Certificate No: D2600V2-1015 Aug20

Page 5 of 6



Report No: HCT-SR-2107-FC004

## Impedance Measurement Plot for Head TSL



Certificate No: D2600V2-1015\_Aug20

Page 6 of 6



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





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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

HCT (Dymstec)

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

Certificate No: D3500V2-1040\_Feb21

CALIBRATION CERTIFICATE 이자 Object D3500V2 - SN:1040 재 H328 Ut/20万 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 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
- 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: 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 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	7777

## 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	SI	PEAG

Certificate 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;  $\sigma = 2.93 \text{ S/m}$ ;  $\varepsilon_r = 37.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.91, 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

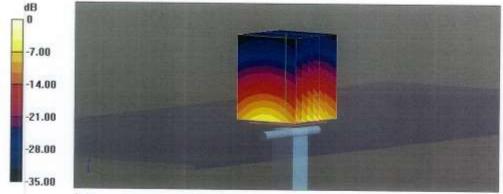
Peak SAR (extrapolated) = 18.1 W/kg

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



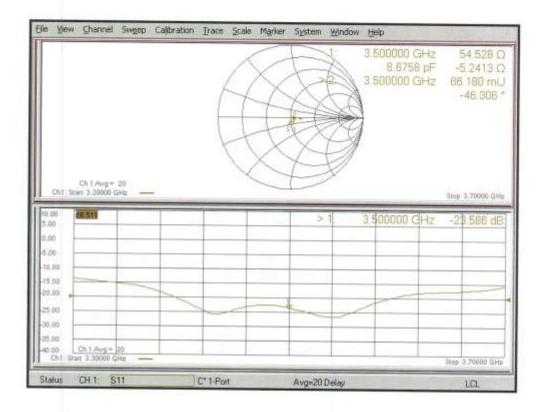
0 dB = 12.7 W/kg = 11.04 dBW/kg

Certificate No: D3500V2-1040\_Feb21 Page 5 of 6



Report No: HCT-SR-2107-FC004

## 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

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: D3700V2-1066\_Nov20

DALIBHATION C	ERTIFICATI	경	답당자	화 인 자
Object	D3700V2 - SN:1	nee 제	H	gri
Oujeur	D3700VZ - SIN; 1	000	SU / UTILES	(EG / 24972
			070 / 12,00	2020/ 12.9
Calibration procedure(s)	QA CAL-22.v5			
	Calibration Proce	edure for SAR Valid	lation Sources t	between 3-10 GHz
Calibration date:	November 19, 20	020		
This calibration certificate docume	ints the traceability to nat	ional standards, which real	ize the physical units	of measurements /SI\
he measurements and the uncor	tainties with confidence p	robability are given on the	following pages and	are part of the certificate
All calibrations have been conduct	ted in the closed laborato	ry facility: environment tem	perature (22 ± 3)°C :	and humidity < 70%
Calibration Equipment used (M&T)	E critical for calibration)			
rimary Standards	ID#	Cal Date (Certificate No	1	Scheduled Calibration
ower meter NRP	SN: 104778	01-Apr-20 (No. 217-031	A STATE OF THE PARTY OF T	Apr-21
ower sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-031		Apr-21
ower sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-031)		Apr-21
eference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-031	200	Apr-21
ype-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-031	0.01	Apr-21
Reference Probe EX3DV4	SN: 3503	31-Dec-19 (No. EX3-35)	The state of the s	Dec-20
AE4	SN: 601	02-Nov-20 (No. DAE4-6	Commence of the Commence of th	Nov-21
	ID#			
Secondary Standards	HLV #	Check Date (in house)		Scheduled Check
Secondary Standards Power meter E4419B	SN: GB39512475	Check Date (in house) 30-Oct-14 (in house che	ck Oct-20)	Scheduled Check
The state of the s	-	30-Oct-14 (in house che	Control of the Contro	In house check: Oct-22
ower meter E44198 ower sensor HP 8461A	SN: GB39512475	30-Oct-14 (in house che 07-Oct-15 (in house che	ck Oct-20)	In house check: Oct-22 In house check: Oct-22
ower meter E44198 ower sensor HP 8461A ower sensor HP 8481A	SN: GB39512475 SN: US37292783 SN: MY41092317	30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che	ck Oct-20) ck Oct-20)	In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Power meter E44196 Power sensor HP 8461A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB39512475 SN: US37292783	30-Oct-14 (in house che 07-Oct-15 (in house che	ck Oct-20) ck Oct-20) ck Oct-20)	Scheduled Check 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 E44196 Power sensor HP 8461A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477	30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che	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
Power meter E44196 Power sensor HP 8461A Power sensor HP 8481A IF generator R&S SMT-06 letwork Analyzer Agilent E8358A	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477	30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che	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
Power meter E44196 Power sensor HP 8461A Power sensor HP 8481A IF generator R&S SMT-06 letwork Analyzer Agilent E8358A	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477	30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che	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 E44196 Power sensor HP 8461A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477 Name Michael Weber	30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che Function Laboratory I	ck Oct-20) ek Oct-20) ek Oct-20) ek 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 E44196 Power sensor HP 8481A Power sensor HP 8481A IF generator R&S SMT-06 letwork Analyzer Agilent E8358A Salibrated by:	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477	30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che Function	ck Oct-20) ek Oct-20) ek Oct-20) ek 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 E44196 Power sensor HP 8461A Power sensor HP 8481A RF generator R&S SMT-06 Retwork Analyzer Agilent E8358A	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477 Name Michael Weber	30-Oct-14 (in house che 07-Oct-15 (in house che 07-Oct-15 (in house che 15-Jun-15 (in house che 31-Mar-14 (in house che Function Laboratory I	ck Oct-20) ek Oct-20) ek Oct-20) ek Oct-20)	In house check: Oct-25 In house check: Oct-25 In house check: Oct-25 In house check: Oct-25 In house check: Oct-25

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
- b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
  of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed
  point exactly below the center marking of the flat phantom section, with the arms oriented
  parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole
  positioned under the liquid filled phantom. The impedance stated is transformed from the
  measurement at the SMA connector to the feed point. The Return Loss ensures low
  reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point.
   No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna 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: D3700V2-1088 Nov20	Done 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 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	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

Manufactured by	SPEAG

Certificate No: D3700V2-1066\_Nov20

Page 4 of 6



Report No: HCT-SR-2107-FC004

## 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;  $\sigma = 3.09 \text{ S/m}$ ;  $\varepsilon_r = 38.4$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

### DASY52 Configuration:

Probe: EX3DV4 - SN3503; ConvF(7.73, 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

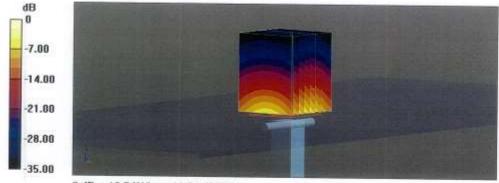
Peak SAR (extrapolated) = 18.6 W/kg

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

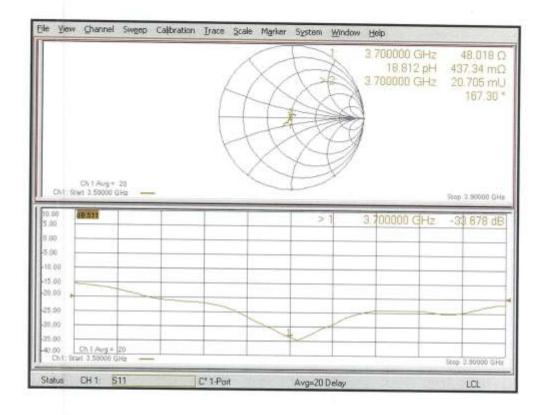
Certificate No: D3700V2-1066\_Nov20

Page 5 of 6



Report No: HCT-SR-2107-FC004

## 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





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 Accorditation 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

ALDEREALITIME.	ERTIFICATE	21	남 당 자	확 인 자
ALIBITATION			796	1n
	was the second	개	86	10
Object	D5GHzV2 - SN:12	253	5w 1 05193	AT 14928
		1 4	1010 / 10,6	2020 / 10.6
alibration procedure(s)	QA CAL-22.v5			
	Calibration Proce	dure for SAR Valid	dation Sources b	oetween 3-10 GHz
Calibration date:	August 31, 2020			
his calibration certificate documer he measurements and the uncert	nts the traceability to national sainties with confidence properties.	onal standards, which resobability are given on the	altze the physical units e following pages and	of measurements (SI), are part of the certificate.
All calibrations have been conducte	ed in the closed laborator	y facility: environment ter	mperature (22 ± 3)°C	and humidity < 70%.
Calibration Equipment used (M&TE	E critical for calibration)			
Primary Standards	ID #	Cal Date (Certificate N	(o.)	Scheduled Calibration
	ID # SN: 104778	Cal Date (Certificate N 01-Apr-20 (No. 217-03	in later	Scheduled Calibration Apr-21
Power meter NRP		The second secon	3100/03101)	
Power meter NRP Power sensor NRP-Z91	SN: 104778	01-Apr-20 (No. 217-03	3100/03101) 3100)	Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03	3100/03101) 3100) 3101)	Apr-21 Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03	3100/03101) 3100) 3101) 3106)	Apr-21 Apr-21 Apr-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: BHB394 (20k)	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03	3100/03101) 3100) 3101) 3106) 3104)	Apr-21 Apr-21 Apr-21 Apr-21
Pawer meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4	SN: 104778 SN: 103244 SN: 103246 SN: BH8394 (20k) SN: 310962 / 06327	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03	3100/03101) 3100) 3101) 3106) 3104) 3503_Dec19)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 3503	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3	3100/03101) 3100) 3101) 3106) 3104) 3503_Dec19) -601_Dec19)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dno-20
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	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4	1100/03101) 1100) 1101) 1101) 1106) 1108) 1109) 1109) 1109) 1109)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198	SN: 104778 SN: 103244 SN: 103245 SN: BH3394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4 Check Date (in house)	1100/03101) 1100) 1101) 1101) 1101) 13104) 1503_Dec19) -601_Dec19) )	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44196 Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH3394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 31-Dec-19 (No. EX3-3 27-Dec-19 (No. DAE4 Check Date (in house)	1100/03101) 3100) 3101) 3106) 3104) 5503_Dec19) -601_Dec19) heck Feb-19)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Disc-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8481A Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH8394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 37-Dec-19 (No. DAE4 Check Date (in house of 07-Oct-14 (in house of	1100/03101) 3100) 3101) 3106) 3104) 5503_Dec19) -601_Dec19) heck Feb-19) heck Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A RF generator R&S SMT-08	SN: 104778 SN: 103244 SN: 103245 SN: BH8394 (20k) SN: 31082 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 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	1100/03101) 1100) 1101) 13106) 13104) 1503_Dec19) -601_Dec19) heck Feb-19) heck Oct-18) heck Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A RF generator R&S SMT-08	SN: 104778 SN: 103244 SN: 103245 SN: BH8394 (20k) SN: 31082 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 31-Dec-19 (No. DAE4 Check Date (in house) 30-Oct-14 (in house of 07-Oct-15 (in house of	1100/03101) 1100) 1101) 13106) 13104) 1503_Dec19) -601_Dec19) heck Feb-19) heck Oct-18) heck Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dac-20 Dec-20 Scheduled Check In house check: Oct-20
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 E44198 Power sensor HP 8481A RF generator R&S SMT-00 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 31-Dec-19 (No. DAE4 Check Date (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 31-Mar-14 (in house of	1100/03101) 1100) 1101) 13106) 13104) 15003_Dec19) 1601_Dec19) 1 heck Feb-19) heck Oct-18) heck Oct-18) heck Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Osc-20 Dec-20 Scheduled Check In house check: Oct-20
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 E44198 Power sensor HP 8481A RF generator R&S SMT-00 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 8H8394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 31-Dec-19 (No. DAE4 Check Date (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 31-Mar-14 (in house of	1100/03101) 1100) 1101) 13106) 13104) 1503_Dec19) -601_Dec19) heck Feb-19) heck Oct-18) heck Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator H& 8481A RF generator H& SMT-08 Network Analyzer Agilent E8358A Calibrated by:	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Jeton Kastrafi	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 31-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 31-Mar-14 (in house of	1100/03101) 1100) 1101) 13104) 13104) 1503 Dec19) -601 Dec19) heck Feb-19) heck Cct-18) heck Cct-18) heck Cct-18) sheck Cct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Onc-20 Dec-20 Scheduled Check In house check: Oct-20
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 E44198 Power sensor HP 8481A RF generator R&S SMT-08 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 01-Apr-20 (No. 217-03 31-Mar-20 (No. 217-03 31-Dec-19 (No. 217-03 31-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 31-Mar-14 (in house of	1100/03101) 1100) 1101) 13106) 13104) 15003_Dec19) 1601_Dec19) 1 heck Feb-19) heck Oct-18) heck Oct-18) heck Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Osc-20 Dec-20 Scheduled Check In house check: Oct-20

Certificate No: D5GHzV2-1253\_Aug20

Page 1 of 8

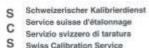


#### Calibration Laboratory of

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







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		ATTE 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

Page 3 of 8



### 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)

Certificate No: D5GHzV2-1253\_Aug20

Page 4 of 8



### 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	$52.0 \Omega + 1.8 \Omega$
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

	No. of the Contract of the Con
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;  $\epsilon_r = 34.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>.

Medium parameters used: f = 5600 MHz;  $\sigma = 4.83$  S/m;  $\epsilon_r = 34.2$ ;  $\rho = 1000$  kg/m<sup>3</sup> . Medium parameters used: f = 5750 MHz;  $\sigma = 4.98$  S/m;  $\epsilon_r = 34.0$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(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



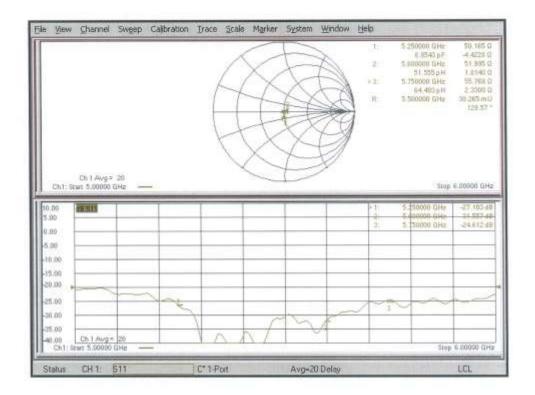


Certificate No: D5GHzV2-1253\_Aug20

Page 7 of 8



## Impedance Measurement Plot for Head TSL



Certificate No: D5GHzV2-1253\_Aug20

Page 8 of 8



## Appendix H. – Power reduction verification

Per the May 2017 TCBC Workshop notes, demonstration of proper functioning of the power reduction mechanism is required to support the corresponding SAR Configurations.

The verification process was divided into two parts:

- 1). Evaluation of output power levels for individual triggering mechanism
- 2) Evaluation of the triggering distances for proximity-based sensors.

### 1. Power Reduction Verification for MB/HB Main Ant

The Power verification was performed according to the following procedure:

- 1. A base station simulator was used to establish a conducted RF connection and output power was monitored. The Power measurements were conformed to be within expected tolerances for all states before and after a power reduction mechanism was triggered.
- 2. Step 1 was repeated for all relevant modes and frequency bands for the mechanism being investigated.
- 3. Step 1 and 2 were repeated for all individual power reduction mechanism and combinations thereof. For the combination cases, one mechanism was switched to a "triggered" state at a time; powers were conformed to be within tolerance after each additional mechanism was activated.



Report No: HCT-SR-2107-FC004

## **Power Reduction Verification for Main Bands**

	1 OWCI 1	toudonon vermou	Conducted Power (dBm	n)
Mechanism(s)	Mode/Band	Un-triggered (Max Power)	Triggered (Reduced Power)	Triggered (Reduced Power)
Grip	UMTS 2	24.53	23.46	
Grip	UMTS 4	24.49	22.44	
Grip	LTE Band 2	24.48	22.72	
Grip	LTE Band 4	24.17	22.36	
Grip	LTE Band 7	23.36	21.43	
Grip	LTE Band 66	24.98	23.12	
Hotspot On	UMTS 2	24.53	23.43	
Hotspot On	UMTS 4	24.49	22.43	
Hotspot On	LTE Band 2	24.48	22.66	
Hotspot On	LTE Band 4	24.17	22.39	
Hotspot On	LTE Band 7	23.36	21.48	
Hotspot On	LTE Band 66	24.98	23.19	
Hotspot On, Then Grip	UMTS 2	24.53	23.40	23.44
Hotspot On, Then Grip	UMTS 4	24.49	22.44	22.49
Hotspot On, Then Grip	LTE Band 2	24.48	22.71	22.69
Hotspot On, Then Grip	LTE Band 4	24.17	22.48	22.42
Hotspot On, Then Grip	LTE Band 7	23.36	21.53	21.49
Hotspot On, Then Grip	LTE Band 66	24.98	23.12	23.07
Grip, then Hotspot On	UMTS 2	24.53	23.41	23.42
Grip, then Hotspot On	UMTS 4	24.49	22.46	22.43
Grip, then Hotspot On	LTE Band 2	24.48	22.68	22.64
Grip, then Hotspot On	LTE Band 4	24.17	22.36	22.31
Grip, then Hotspot On	LTE Band 7	23.36	21.44	21.47
Grip, then Hotspot On	LTE Band 66	24.98	23.16	23.12



### 1.1. Distance Verification Procedure

Procedures for determining proximity sensor triggering distances

(KDB 616217D04v01r02§6.2)

The distance verification procedure was performed according to the following procedure:

- 1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.
- 2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 .Each applicable test position was evaluated. The distance were conformed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
- 3. Step 1 and 2 were repeated for the relevant modes, as appropriate
- 4. Steps1 through 3 were repeated for all distance-based power reduction mechanisms.

For detailed measurement conducted power results, please refer to the Section .11



Proximity Sensor Trigger Distance Assessment KDB 616217 D04§6.2 (Rear / Front / Bottom side)

#### **LEGEND**

- Direction of DUT travel for determination of power reduction triggering point
- → Direction of DUT travel for determination of full power resumption triggering point

	Trigger dist	ance - Rear	Trigger dista	Trigger distance - Front Trigger distance - Bot				
Tissue simulating liquid	Moving toward phantom [mm]	Moving away from phantom [mm]		Moving away from phantom [mm]		Moving away from phantom [mm]		
1800MHz Tissue	15	16	7	8	8	9		
1900MHz Tissue	15	16	7	8	8	9		
2600 MHz Tissue	15	16	7	8	8	9		

Distance Measurement verification for Proximity sensor



Report No: HCT-SR-2107-FC004

## Rear side – EUT Moving toward (trigger) to the Phantom

Mode				Distance	to DUT Οι	Output power (dBm)				
Wiode	20[mm]	19[mm]	18[mm]	17[mm]	16[mm]	15[mm]	14[mm]	13[mm]	12[mm]	11[mm]
UMTS B2	24.46	24.44	24.45	24.42	24.45	23.49	23.53	23.49	23.45	23.38
UMTS B4	24.05	24.01	24.06	24.07	24.00	22.47	22.39	22.59	22.39	22.51
LTE Band 2	24.51	24.56	24.52	24.52	24.55	22.52	22.52	22.71	22.72	22.55
LTE Band 4	24.37	24.34	24.42	24.40	24.43	22.81	22.92	22.90	22.95	22.88
LTE Band 7	23.25	23.24	23.26	23.22	23.19	21.46	21.56	21.46	21.39	21.48
LTE Band 66	24.98	24.97	24.99	24.90	24.89	23.20	23.25	23.15	23.22	23.23

## Rear side – EUT Moving away (Release) from the Phantom

Mode				Distance	to DUT O	utput powe	er (dBm)			
Wode	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]	17[mm]	18[mm]	19[mm]	20[mm]	21[mm]
UMTS B2	23.50	23.43	23.49	23.38	23.42	24.46	24.41	24.55	24.47	24.56
UMTS B4	22.49	22.58	22.56	22.45	22.48	24.05	24.03	24.07	24.18	24.07
LTE Band 2	22.53	22.58	22.62	22.53	22.57	24.55	24.62	24.48	24.67	24.53
LTE Band 4	22.92	22.95	22.95	22.80	22.93	24.35	24.52	24.37	24.49	24.38
LTE Band 7	21.56	21.53	21.46	21.54	21.55	23.28	23.36	23.31	23.25	23.28
LTE Band 66	23.20	23.23	23.24	23.19	23.19	24.97	24.98	24.97	25.01	24.93

## Front side – EUT Moving toward (trigger) to the Phantom

Mode				Distance to	DUT Out	put powe	r (dBm)			
wode	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm]	3[mm]
UMTS B2	24.56	24.55	24.50	24.42	24.57	23.47	23.43	23.46	23.58	23.46
UMTS B4	24.05	24.14	23.99	24.11	24.10	22.55	22.53	22.52	22.48	22.58
LTE Band 2	24.52	24.57	24.47	24.63	24.51	22.53	22.58	22.64	22.61	22.65
LTE Band 4	24.50	24.44	24.39	24.39	24.54	22.86	22.85	22.82	22.87	22.94
LTE Band 7	23.30	23.20	23.23	23.31	23.38	21.39	21.39	21.41	21.53	21.48
LTE Band 66	25.10	25.05	24.91	25.01	25.01	23.15	23.31	23.26	23.21	23.32



Report No: HCT-SR-2107-FC004

Front side – EUT Moving away (Release) from the Phantom

Mode				Distar	nce to DU	Γ Output μ	oower (dBm	1)		
Wode	4[mm]	5[mm]	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]
UMTS B2	23.48	23.40	23.39	23.57	23.55	24.54	24.43	24.58	24.47	24.46
UMTS B4	22.59	22.44	22.41	22.48	22.49	24.04	24.01	24.18	24.12	24.16
LTE Band 2	22.54	22.66	22.64	22.57	22.57	24.48	24.57	24.50	24.59	24.49
LTE Band 4	22.93	22.96	22.79	22.76	22.76	24.54	24.46	24.45	24.54	24.40
LTE Band 7	21.48	21.51	21.57	21.56	21.42	23.35	23.32	23.23	23.26	23.37
LTE Band 66	23.34	23.28	23.17	23.20	23.16	24.94	24.96	24.99	24.97	25.05

## Bottom side – EUT Moving toward (trigger) to the Phantom

Mode				Distance to	DUT Outp	ut power	(dBm)			
Wode	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm]
UMTS B2	24.55	24.51	24.45	24.55	24.45	23.56	23.50	23.49	23.47	23.54
UMTS B4	24.04	24.11	24.16	24.14	24.00	22.55	22.54	22.52	22.54	22.43
LTE Band 2	24.60	24.54	24.64	24.67	24.48	22.57	22.70	22.53	22.62	22.63
LTE Band 4	24.45	24.43	24.43	24.37	24.45	22.83	22.80	22.86	22.92	22.79
LTE Band 7	23.33	23.27	23.37	23.30	23.24	21.47	21.56	21.53	21.39	21.49
LTE Band 66	24.98	25.00	24.93	25.08	24.97	23.18	23.31	23.16	23.19	23.30

## Bottom side - EUT Moving away (Release) from the Phantom

Mode				Dista	nce to DU	T Output p	ower (dBm	)		
Mode	5[mm]	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]
UMTS B2	23.54	23.50	23.48	23.46	23.52	24.56	24.57	24.52	24.42	24.48
UMTS B4	22.39	22.39	22.44	22.59	22.56	24.01	24.18	24.10	24.15	24.18
LTE Band 2	22.61	22.59	22.57	22.59	22.62	24.49	24.53	24.66	24.57	24.53
LTE Band 4	22.86	22.94	22.94	22.94	22.93	24.46	24.38	24.45	24.52	24.43
LTE Band 7	21.49	21.57	21.53	21.54	21.46	23.25	23.30	23.33	23.18	23.25
LTE Band 66	23.32	23.18	23.28	23.25	23.18	24.94	25.10	24.97	25.03	25.08



## 1.2 Proximity Sensor Coverage for SAR measurements

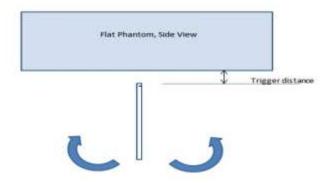
(KDB 616217 D04v01r02§6.3)

As there is no spatial offset between the antenna and the proximity sensor element, proximity sensor coverage did not need to be assessed.

## 1.3 Proximity Sensor Tilt Angle Assessment

(KDB 616217 D04v01r02 §6.4)

The DUT was positioned directly below the flat phantom at the minimum measured trigger distance with Bottom side parallel to the base of the flat phantom for each band. The EUT was rotated about Bottom side for angles up to  $\pm 45^{\circ}$ . If the output power increased during the rotation the DUT was moved 1mm toward the phantom and the rotation repeated. This procedure was repeated until the power remained reduced for all angles up $\pm 45^{\circ}$ .



Proximity sensor tilt angle assessment (Bottom side) KDB 616217 §6.4

## Summary of Tablet Tilt Angle influence to Proximity Sensor Triggering (Bottom side)

	Minimumdistance					Pov	ver reduc	tion statu	IS			
Tissue	atwhich power reduction was maintained over- 45°	-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
1800 MHz Tissue	8 mm	On	On	On	On	On	On	On	On	On	On	On
1900 MHz Tissue	8 mm	On	On	On	On	On	On	On	On	On	On	On
2600 MHz Tissue	8 mm	On	On	On	On	On	On	On	On	On	On	On



## 1.5 Resulting test positions for Phablet SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for Phablet SAR [mm]
	Rear	15	N/A	N/A	14
WWAN (UMTS B2/B4 /LTEB2/B4/B7/B66)	Front	7	N/A	N/A	6
,	Bottom	8	N/A	N/A	7

Note: FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device when being used in phablet use conditions



### 2. Power reduction Verification for B48 Main Ant

This device uses a power reduction mechanism for SAR compliance for LTE band 48 operations during voice or VoIP held to ear scenarios. (i.e. reducing output power for Head SAR compliance)

Detailed descriptions of the power reduction mechanism are included in the Main operational description document

Condition	Wireless	Conducted	Power[dBm]
For Power reduction	Technologies	Un-Triggered (Max Power)	Triggered (Reduced Power)
RCV-on	LTE 48	23.73	20.77

### 3. Power reduction Verification for WLAN Ant

This device uses a power reduction mechanism for SAR compliance for WLAN operations during voice or VoIP held to ear scenarios.

When a user makes or receives a WLAN voice or WLAN VOIP call for WLAN Ant the audio of the call is sent through the Receiver at the top of the device will trigger the Power reduction for WLAN Ant (i.e. reducing output power for Head SAR compliance)

Detailed descriptions of the power reduction mechanism are included in the Main operational description document

Condition	Wireless	Conducted	Power[dBm]
For Power reduction	Technologies	Un-Triggered (Max Power)	Triggered (Reduced Power)
RCV-on	2.4GHz 802.11b (Exclude 12/13ch)	20.81	11.40
RCV-on	2.4GHz 802.11g (Exclude 12/13ch))	18.51	11.69
RCV-on	2.4GHz 802.11n (Exclude 12/13ch)	18.75	11.41
RCV-on	5GHz 802.11a (Exclude 100~144ch)	18.57	10.78
RCV-on	5GHz 802.11n 20MHz	18.40	10.92
RCV-on	5GHz 802.11n 40MHz	17.25	11.55
RCV-on	5GHz 802.11ac 20MHz	18.19	11.75
RCV-on	5GHz 802.11ac 40MHz	16.14	11.68
RCV-on	5GHz 802.11ac 80MHz	14.36	11.84



# **Appendix I. – Down-link CA Power Measurement**



## 1. LTE Down-link Carrier Aggregation Conducted Powers

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number component carriers(CCs) supported by test product implementation. For those configurations required by April 2018 TCBC Workshop notes, conducted power measurements with LTE Carrier Aggregation(CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s)(SCC) on the downlink only.

#### **Downlink Carrier aggregation:**

- This device only supports downlink carrier aggregation. For every supported combination of downlink carrier aggregation, power measurements were performed with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.
- 2. All control and acknowledge data is sent on uplink channels that operate identical to specifications when downlink carrier aggregation is inactive.
- 3. Per FCC KDB publication 941225 D05A v01r02, Section C)3)b)ii), PCC uplink channel was selected at downlink carrier aggregation combinations. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation.
- For continuous intra-band carrier aggregation, the downlink channel spacing between the component carriers was set to multiple of 300kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521.
- 5. For non-continuous intra-band carrier aggregation, the downlink channel spacing between the component carriers was set to be larger than the nominal channel spacing and provided maximum separation between the component carriers.
- 6. All selected downlink channels remained fully within the downlink transmission band of the respective component carrier.

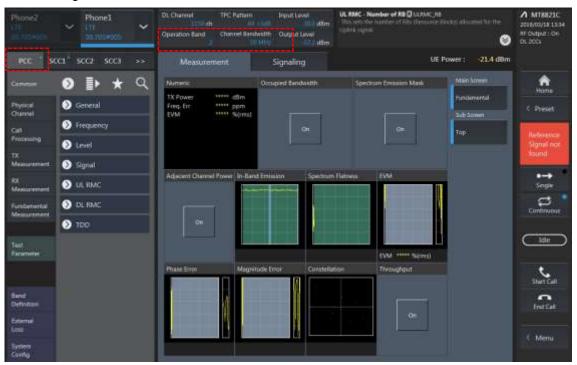


Power Measurement setup

## Report No: HCT-SR-2107-FC004

## LTE Down Link 2CA Call Setup

## PCC Setting : Channel/ RB/ BW/ Modulation



## SCC Setting: Channel/RB/BW/ Modulation and call Connection





## **2CA Downlink Carrier aggregation Maximum conducted Powers**

					PCC					SCC Tx Power					Power	
Combination	Band	BW	PCC UL Ch.	PCC UL Freq.		PCC DL Freq.	Modul ation	RB	RB offset	Band	BW	SCC DL Ch.	SCC DL Freq.	LTE Single Carrier Tx Power (dBm) (1)	LTE Tx Power with DL CA Enabled (dBm) (2)	Delta (2)-(1 <b>)</b>
2A-4A(1)	2	10	18900	1880	900	1960	QPSK	1	24	4	10	2175	2132.5	24.45	24.28	-0.17
2A-4A(2)	2	20	19100	1900	1100	1980	QPSK	1	0	4	20	2175	2132.5	24.48	24.24	-0.24
2A-4A(1)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	2	10	900	1960	24.40	24.25	-0.15
2A-4A(2)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	2	20	900	1960	24.40	24.26	-0.14
2A-5A(1)	2	10	18900	1880	900	1960	QPSK	1	24	5	10	2525	881.5	24.45	24.42	-0.03
2A-5A(1)	5	10	20525	836.5	2525	881.5	QPSK	1	0	2	10	900	1960	24.05	23.99	-0.06
2A-12A(2)	2	10	18900	1880	900	1960	QPSK	1	24	12	10	5095	737.5	24.45	24.48	0.03
2A-12A(2)	12	10	23095	707.5	5095	737.5	QPSK	1	0	2	10	900	1960	24.65	24.61	-0.04
2A-13A(1)	2	10	18900	1880	900	1960	QPSK	1	24	13	10	5230	751	24.45	24.46	0.01
2A-13A(1)	13	10	23230	782	5230	751	QPSK	1	0	2	10	900	1960	24.04	24.12	80.0
2A-66A(2)	2	20	19100	1900	1100	1980	QPSK	1	0	66	20	66786	2145	24.48	24.44	-0.04
2A-66A(2)	66	15	132322	1745	66786	1745	QPSK	1	74	2	20	900	1960	25.00	24.81	-0.19
4A-4A(1)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	4	10	2000	2115	24.4	24.26	-0.14
4A-5A(1)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	5	10	2525	881.5	24.4	24.24	-0.16
4A-5A(1)	5	10	20525	836.5	2525	881.5	QPSK	1	0	4	20	2175	2132.5	24.05	23.93	-0.12
5A-5A(1)	5	3	20635	847.5	2635	892.5	QPSK	1	0	5	5	2407	869.7	23.96	23.90	-0.06
5B(1)	5	3	20635	847.5	2635	892.5	QPSK	1	0	5	5	2486	877.6	23.96	24.10	0.14
12A-66A(2)	12	5	23155	713.5	5155	743.5	QPSK	1	0	66	20	66786	2145	24.70	24.59	-0.11
12A-66A(3)	12	5	23155	713.5	5155	743.5	QPSK	1	0	66	10	66786	2145	24.70	24.64	-0.06
12A-66A(4)	12	5	23155	713.5	5155	743.5	QPSK	1	0	66	20	66786	2145	24.70	24.59	-0.11
12A-66A(5)	12	5	23155	713.5	5155	743.5	QPSK	1	0	66	15	66786	2145	24.70	24.66	-0.04
12A-66A(2)	66	15	132322	1745	66786	1745	QPSK	1	74	12	10	5095	737.5	25.00	24.88	-0.12
12A-66A(3)	66	10	132622	1775	67086	2175	QPSK	1	0	12	10	5095	737.5	24.77	24.89	0.12
12A-66A(4)	66	15	132322	1745	66786	1745	QPSK	1	74	12	10	5095	737.5	25.00	24.90	-0.1
12A-66A(5)	66	15	132322	1745	66786	1745	QPSK	1	74	12	5	5095	737.5	25.48	24.89	-0.59

Report No: HCT-SR-2107-FC004



## LTE Down Link 3CA Call Setup

1) PCC Setting: Channel /RB/BW/Modulation



2) SCC1 Setting: Channel/RB/BW/Modulation





## 3) SCC2 Setting (Channel /RB/BW/Modulation )and call Connection





## 3CA Downlink Carrier aggregation Maximum conducted Powers

					PCC							SCC				SCC		Tx P	ower	
Combination	Band	BW	PCC UL Ch.	PCC UL Freq.	PCC DL Ch.	PCC DL Freq.	Modul ation	RB	RB offset	Band	BW	SCC DL Ch.	SCC DL Freq.	Band		SCC DL Ch.	SCC DL Freq.	LTE Single Carrier Tx Power (dBm) (1)	LTE Tx	Delta (2)-(1 <b>)</b>
13A-66A-66A(0)	13	10	23230	782	5230	751	QPSK	1	0	66	20	66786	2145	66	20	67236	2190	24.04	24.25	0.21
13A-66A-66A(0)	66	15	132322	1745	66786	2145	QPSK	1	74	13	10	5230	751	66	20	67236	2190	25.00	24.86	-0.14
13A-66B(0)	13	10	23230	782	5230	751	QPSK	1	0	66	15	66786	2145	66	5	66879	2154.3	24.04	24.26	0.22
13A-66B(0)	66	15	132322	1745	66786	2145	QPSK	1	74	66	5	66879	2154.3	13	10	5230	751	25.00	24.88	-0.12
13A-66C(0)	13	10	23230	782	5230	751	QPSK	1	0	66	20	66786	2145	66	20	66588	2125.2	24.04	24.28	0.24
13A-66C(0)	66	15	132322	1745	66786	2145	QPSK	1	74	66	20	66615	2127.9	13	10	5230	751	25.00	24.87	-0.13
66A-66C(0)	66	15	132322	1745	66786	2145	QPSK	1	74	66	20	67038	2170.2	66	20	67236	2190	25.00	24.87	-0.13
66A-66C(0)	66	15	132322	1745	66786	2145	QPSK	1	74	66	20	66615	2127.9	66	20	67236	2190	25.00	24.88	-0.12
66A-66A-66A(0)	66	15	132322	1745	66786	2145	QPSK	1	74	66	20	67236	2190	66	20	66536	2120	25.00	24.88	-0.12
2A-2A-4A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	2	20	700	1940	4	20	2175	2132.5	24.48	24.41	-0.07
2A-2A-4A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	2	20	900	1960	2	20	1100	1980	24.40	24.27	-0.13
2A-2A-5A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	2	20	700	1940	5	10	2525	881.5	24.48	24.36	-0.12
2A-2A-5A(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	2	20	900	1960	2	20	1100	1980	24.05	23.94	-0.11
2A-2A-12A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	2	20	700	1940	12	10	5095	737.5	24.48	24.24	-0.24
2A-2A-12A(0)	12	5	23155	713.5	5095	737.5	QPSK	1	0	2	20	900	1960	2	20	1100	1980	24.70	24.13	-0.57
2A-2A-13A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	2	20	700	1940	13	10	5230	751	24.48	24.25	-0.23
2A-2A-13A(0)	13	10	23230	782	5230	751	QPSK	1	0	2	20	900	1960	2	20	1100	1980	24.04	24.27	0.23
2A-2A-66A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	2	20	700	1940	66	20	66786	2145	24.48	24.45	-0.03
2A-2A-66A(0)	66	15	132322	1745	66786	2145	QPSK	1	74	2	20	900	1960	2	20	1100	1980	25.00	24.89	-0.11
2A-4A-4A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	4	20	2175	2132.5	4	10	2000	2115	24.48	24.40	-0.08
2A-4A-4A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	2	20	900	1960	4	20	2175	2132.5	24.40	24.35	-0.05
2A-4A-5A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	4	20	2175	2132.5	5	10	2525	881.5	24.48	24.41	-0.07
2A-4A-5A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	2	20	900	1960	5	10	2525	881.5	24.40	24.27	-0.13
2A-4A-5A(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	2	20	900	1960	4	20	2175	2132.5	24.05	24.23	0.18
2A-4A-13A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	4	20	2175	2132.5	13	10	5230	751	24.48	24.46	-0.02
2A-4A-13A(0)	4	5	_	1752.5	2375	2152.5	QPSK	1	24	2	20	900	1960	13	10	5230	751	24.40	24.42	0.02
2A-4A-13A(0)	13	10	23230	782	5230	751	QPSK	1	0	2	20	900	1960	4	20	2175	2132.5	24.04	24.14	0.10
2A-5A-66A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	5	10	2525	881.5	66	20	66786	2145	24.48	24.42	-0.06
2A-5A-66A(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	2	20	900	1960	66	20	66786	2145	24.05	24.10	0.05
2A-5A-66A(0)	66		132322	1745	66786	2145	QPSK	1	74	2	20	900	1960	5	10	2525	881.5	25.00	24.87	-0.13
2A-5B(0)	2	20	19100	1900	1100	1980	QPSK	1	0	5	10	2525	881.5	5	10	2426	871.6	24.48	24.42	-0.06
2A-5B(0)	_		20525		2525		QPSK	_	0	5	10	2426	871.6	2	20	900	1960	24.05	24.10	0.05
	_		19100	1900	1100		QPSK	_	0	12	10	5095	737.5	66	20	66786	2145	24.48	24.31	-0.17
2A-12A-66A(1)	_	5		1880	900		QPSK		24	12	10	5095	737.5	66	20	66786	2145	24.45	24.56	0.11
2A-12A-66A(0)	_	_	23155		5155		QPSK	_	0	2	20	900	1960	66	20	66786	2145	24.70	24.81	0.11
2A-12A-66A(1)	_	_	23155		5155		QPSK		0	2	10	900	1960	66	20	66786	2145	24.70	24.80	0.10
2A-12A-66A(0)	_	_				2117.5		_	0	2	20	900	1960	12	10	5095	737.5	25.00	24.75	-0.25
2A-12A-66A(1)	_	_				2117.5			0	2	10	900	1960	12	10	5095	737.5	25.00	24.70	-0.30
2A-13A-66A(0)	_	_		1900	1100		QPSK		0	13	10	5230	751	66	20	66786	2145	24.48	24.38	-0.10
2A-13A-66A(0)	_	_		782	5230		QPSK	_	0	2	20	900	1960	66	20	66786	2145	24.04	24.14	0.10
2A-13A-66A(0)	_			1745	66786		QPSK	_	74	13	10	5230	751	2	20	900	1960	25.00	24.77	-0.23
2A-66A-66A(0)	-		19100	1900	1100		QPSK	_	0	66	20	66786	2145	66	20	67236	2190	24.48	24.46	-0.02
· · · · · · · · · · · · · · · · · · ·	-		132322	1745	66786		QPSK	_	74	66	20	67236	2190	2	20	900	1960	25.00	25.00	0.00
2A-66B(0)	-		19100	1900	1100		QPSK		0	66	15	66786	2145	66	5	66693	2135.7	24.48	24.42	-0.06
2A-66B(0)	-		132322	1745	66786		QPSK	_	74	66	5	66693		2	20	900	1960	25.00	25.09	0.09
2A-66C(0)	2	20	19100	1900	1100	1980	QPSK	1	0	66	20	66786	2145	66	20	66984	2164.8	24.48	24.43	-0.05



1			1		1		l l		1 .									1		
1			132322		66786	2145	QPSK	1	74	66	20	66957	2162.1	2	20	900	1960	25.00	24.90	-0.1
4A-4A-5A(0)	4	5		1752.5	2375	2152.5	QPSK	1	24	4	20	2175	2132.5	5	10	2525	881.5	24.40	24.22	-0.18
4A-4A-5A(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	4	20	2175	2132.5	4	10	2000	2115	24.05	24.04	-0.01
4A-4A-13A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	4	20	2175	2132.5	13	10	5230	751	24.40	24.35	-0.05
4A-4A-13A(0)	13	_	23230	782	5230	751	QPSK	1	0	4	20	2175	2132.5	4	10	2000	2115	24.04	24.28	0.24
4A-5B(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	5	10	2525	881.5	5	5	2597	888.7	24.40	24.35	-0.05
4A-5B(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	5	5	2597	888.7	4	20	2175	2132.5	24.05	24.04	-0.01
5A-5A-66A(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	5	5	2425	871.5	66	20	66786	2145	24.05	24.05	0.00
5A-5A-66A(0)	66	15	132322	1745	66786	2145	QPSK	1	74	5	10	2525	881.5	5	5	2425	871.5	25.00	24.84	-0.16
5A-66B(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	66	15	66786	2145	66	5	66879	2154.3	24.48	24.18	-0.3
5A-66B(0)	66	15	132322	1745	66786	2145	QPSK	1	74	66	5	66879	2154.3	5	10	2525	881.5	25.00	24.82	-0.18
5A-66C(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	66	20	66786	2145	66	20	66984	2164.8	24.48	24.13	-0.35
5A-66C(0)	66	15	132322	1745	66786	2145	QPSK	1	74	66	20	66957	2162.1	5	10	2525	881.5	25.00	24.84	-0.16
5B-66A(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	5	10	2624	891.4	66	20	66786	2145	24.48	24.20	-0.28
5B-66A(0)	66	15	132322	1745	66786	2145	QPSK	1	74	5	5	2525	881.5	5	10	2597	888.7	25.00	24.86	-0.14
5A-66A-66A(0)	5	10	20525	836.5	2525	881.5	QPSK	1	0	66	20	66786	2145	66	20	67236	2190	24.05	24.04	-0.01
5A-66A-66A(0)	66	15	132322	1745	66786	2145	QPSK	1	74	5	10	2525	881.5	66	20	67236	2190	25.00	24.80	-0.20
12A-66A-66A(0)	12	5	23155	713.5	5155	743.5	QPSK	1	0	66	20	66786	2145	66	20	67236	2190	24.70	24.79	0.09
12A-66A-66A(0)	66	15	132047	1717.5	66511	2117.5	QPSK	1	0	12	10	5095	737.5	66	20	67236	2190	25.00	24.81	-0.19
2A-4A-7A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	4	20	2175	2132.5	7	20	3100	2655	24.48	24.43	-0.05
2A-4A-7A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	2	20	900	1960	7	20	3100	2655	24.40	24.30	-0.1
2A-4A-7A(0)	7	20	20850	2510	2850	2630	QPSK	1	0	2	20	900	1960	4	20	2175	2132.5	23.36	23.35	-0.01
2A-4A-29A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	4	20	2175	2132.5	29	10	9715	722.5	24.48	24.31	-0.17
2A-4A-29A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	2	20	900	1960	29	10	9715	722.5	24.40	24.26	-0.14
2A-7A-7A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	7	20	3350	2680	7	20	3100	2655	24.48	24.42	-0.06
2A-7A-7A(0)	7	20	20850	2510	2850	2630	QPSK	1	0	7	20	3100	2655	2	20	900	1960	23.36	23.32	-0.04
2A-7A-12A(0)	2	20	19100	1900	1100	1980	QPSK	1	0	7	20	3350	2680	12	10	5095	737.5	24.48	24.38	-0.10
2A-7A-12A(0)	7	20	20850	2510	2850	2630	QPSK	1	0	2	20	900	1960	12	10	5095	737.5	23.36	23.46	0.10
2A-7A-12A(0)	12	5	23155	713.5	5155	743.5	QPSK	1	0	2	20	900	1960	7	20	3100	2655	24.70	24.05	-0.65
2A-12B(0)	2	20	19100	1900	1100	1980	QPSK	1	0	12	5	5095	737.5	12	10	5167	744.7	24.48	24.37	-0.11
2A-12B(0)	12	5	23155	713.5	5155	743.5	QPSK	1	0	12	10	5083	736.3	2	20	900	1960	24.70	24.73	0.03
4A-4A-7A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	4	10	2000	2115	7	20	3100	2655	24.40	24.27	-0.13
4A-4A-7A(0)	7	20	20850	2510	2850	2630	QPSK	1	0	4	10	2175	2132.5	4	10	2000	2115	23.36	23.34	-0.02
4A-4A-7A(1)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	4	20	2050	2120	7	20	3100	2655	24.40	24.24	-0.16
4A-4A-7A(1)	7	20	20850	2510	2850	2630	QPSK	1	0	4	20	2175	2132.5	4	10	2000	2115	23.36	23.33	-0.03
4A-4A-12A(0)	4	5	20375	1752.5	2375	2152.5	QPSK	1	24	4	20	2050	2120	12	10	5095	737.5	24.40	24.15	-0.25
4A-4A-12A(0)	12	5	23155	713.5	5155	743.5	QPSK	1	0	4	20	2175	2132.5	4	10	2000	2115	24.70	24.75	0.05
4A-7A-7A(0)			20375						24	7	20	3350	2680	7	20	3100	2655	24.40	24.39	-0.01
4A-7A-7A(0)			20850		2850		QPSK		0	7	20	3350	2680	4	20	2300	2145	23.36	23.35	-0.01
4A-7A-12A(0)			20375				QPSK			7	20	3100	2655	12	10	5095	737.5	24.40	24.15	-0.25
4A-7A-12A(0)			20850		2850		QPSK		0	4	10	1	2132.5	12	10	5095	737.5	23.36	23.47	0.11
- · · ·			23155				QPSK		0	4	10		2132.5	7	20	3100	2655	24.70	24.76	0.06
4A-12B(0)			20375				QPSK		24	12	10	5095	737.5	12	5	5167	744.7	24.40	24.26	-0.14
- · · · ·			23155				QPSK		0	12	10	5083	736.3	4	20		2132.5	24.70	24.68	-0.02
7A-12B(0)			20850		2850		QPSK		0	12	10	5095	737.5	12	5	5167	744.7	23.36	23.43	0.07
			23155				QPSK		0	12	10	5083	736.3	7	20	3100	2655	24.70	24.73	0.03
17. 12D(V)			20100		0.00	0.0	α. Oπ	<u>'</u>				0000	100.0		_0	0.00	2000	27.70	£7.10	0.00