

Report No: HCT-SR-2103-FC002

# **Appendix G. – Dipole Calibration Data**



Report No: HCT-SR-2103-FC002

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: D750V3-1014 May20

Object	D750V3 - SN:101	14	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	s between 0.7-3 GHz 화연자
Calibration dute:	May 19, 2020	1 4200 16-11	200 1 200
This calibration certificate documen	nts the traceability to nati	onal standards, which realize the physical un	its of measurements (SI).
The measurements and the uncert	ainties with confidence p	robability are given on the following pages ar	nd are part of the certificate.
All calibrations have been conduction.  Calibration Equipment used (M&TE)		ry facility: environment temperature (22 $\pm$ 3)°	C and humidity < 70%.
rimary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power 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
OND REMOVE THEY SEED			
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
ower sensor NRP-Z91	SN: 103245 SN: 8H9394 (20k)		Apr-21 Apr-21
Power sensor NRP-Z91 Reference 20 dB Attemuator Type-N mismatch combination		01-Apr-20 (No. 217-03101)	0.000
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: BH9394 (20k)	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03108)	Apr-21
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 8H9394 (20k) SN: 310962 / 06327	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03108) 31-Mar-20 (No. 217-03104)	Apr-21 Apr-21
Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19)	Apr-21 Apr-21 Dec-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19)	Apr-21 Apr-21 Dec-20 Dec-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house)	Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter E4419B Power sensor HP 8481A	SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (In house check Feb-19)	Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check; Oct-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power mater E4419B Power sensor HP 8481A	SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 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)	Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check; Oct-20 In house check; Oct-20
Power sensor NRP-Z91 Reterence 20 dB Attenuator Type-N mismatch combination Reterence Probe EX3DV4 DAE4 Recondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03108) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7348_Dec19) 27-Dec-19 (No. DAE4-801_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18)	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 sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03108) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Apr-21 Apr-21 Dec-20 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 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 E8358A	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 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)	Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477 Name	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 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)	Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check; Oct-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477 Name	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 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)	Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check; Oct-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RP generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: BH9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601 ID # SN: GB99512475 SN: US37292783 SN: MY41092317 SN: US41090477 Name Jeffrey Katzman	01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-7349_Dec19) 27-Dec-19 (No. DAE4-801_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 Laboratory Technician	Apr-21 Apr-21 Dec-20 Dec-20 Scheduled Check In house check; Oct-20

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





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

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Multilateral Agreement for the recognition of calibration certificates

Glossarv:

TSL tissue simulating liquid

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

Calibration is Performed According to the Following Standards:

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

 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%.

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#### **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	42.1 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	6005	alam.

## 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	2.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.39 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	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.53 W/kg ± 16.5 % (k=2)

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω + 3.0 jΩ	
Return Loss	- 26.5 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.041 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

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Manufacture	d by	SPEAG	

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

Date: 19.05.2020

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

#### DASY52 Configuration:

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

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

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 58.88 V/m; Power Drift = 0.00 dB

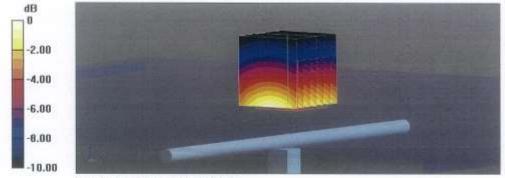
Peak SAR (extrapolated) = 3.18 W/kg

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

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

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

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

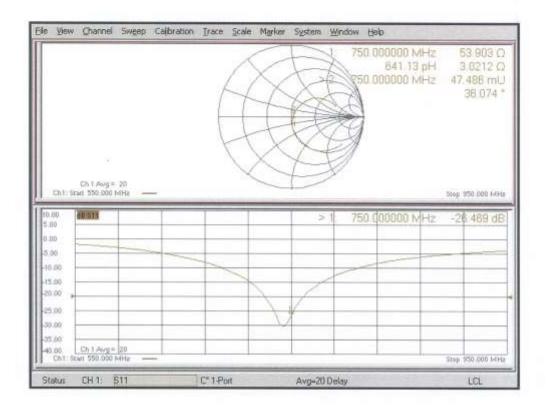


0 dB = 2.81 W/kg = 4.49 dBW/kg

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## Impedance Measurement Plot for Head TSL



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





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Client HCT (Dymstec)

Certificate No: D835V2-4d165\_Jul20

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nis calibration certificate documen	its the traceability to natio	onal standards, which realize the physical uni	ts of measurements (SI).
ne measurements and the uncertain	sinties with confidence pr	robability are given on the following pages an	d are part of the certificate,
calibrations have been conducte	ed in the closed laborator	ry facility: environment temperature (22 ± 3)°C	and humidity < 70%.
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alibration Equipment used (M&TE	critical for calibration)		
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rimary Standards	1D#	Gal Date (Certificate No.)	Scheduled Calibration
ower meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
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ower sensor NRP-ZB1	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
ower sensor NRP-Z91	SN: 103244 SN: 103245		
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ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator	SN: 103245	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101)	Apr-21 Apr-21
ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination	SN: 103245 SN: BH9394 (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
ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator	SN: 103245 SN: BH9394 (20k)	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106)	Apr-21 Apr-21 Apr-21 Apr-21
ower sensor NRP-ZB1 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination leference Probe EX30V4	SN: 103245 SN: BH9394 (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 Apr-21 Jun-21
ower sensor NRP-ZB1 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination leference Probe EX30V4	SN: 103245 SN: BH9394 (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 Apr-21 Jun-21
ower sensor NRP-ZB1 ower sensor NRP-291 eference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 AE4	SN: 103245 SN: BH9394 (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 Scheduled Check In house check: Oct-20
ower sensor NRP-ZB1 ower sensor NRP-ZB1 eference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 AE4 econdary Standards	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7348 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)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check
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ower sensor NRP-ZB1 ower sensor NRP-ZB1 eference 20 dB Attenuator ype-N mismatch combination laterance Probe EX3DV4 IAE4 secondary Standards lower meter E4419B lower sensor HP B481A	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 Oate (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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ower sensor NRP-ZB1 ower sensor NRP-ZB1 eference 20 dB Attenuator ype-N mismatch combination interance Probe EX3CV4 AE4 econdary Standards tower meter E4419B tower sensor HP 8481A forwar sensor HP 8481A is generator R&S SMT-06 letwork Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7348 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 SN: 100972 SN: US41080477 Name	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. DAE4-801_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-19)  Function Luboratory-Technician	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20

Certificate No: D835V2-4d165\_Jul20

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Report No: HCT-SR-2103-FC002

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S Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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#### Glossary:

TSL tissue simulating liquid

ConvF sensitivity in TSL / NORM x,y,z

N/A not applicable or not measured

## Calibration is Performed According to the Following Standards:

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

### Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

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## Measurement Conditions

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

Distance Dipole Center - TSL 15 mm	V52.10.4
Distance Dipole Center - TSL 15 mm	
Zoom Scan Resolution dx, dy, dz = 5 mm	with Spacer
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 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	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.56 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.21 W/kg ± 16.5 % (k=2)

Certificate No: D835V2-4d165\_Jul20

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.3 Ω - 2.6 μΩ
Return Loss	- 30,9 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.443 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
11101101010101010101	

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Report No: HCT-SR-2103-FC002

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

Date: 28.07.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d165

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

Medium parameters used: f = 835 MHz;  $\sigma = 0.93$  S/m;  $\epsilon_r = 42.2$ ;  $\rho = 1000$  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:

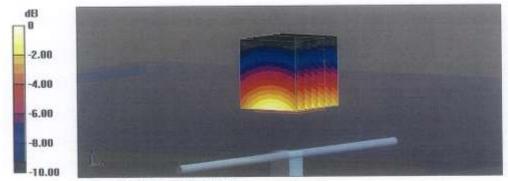
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 62.81 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.62 W/kg

SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.58 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 66.6% Maximum value of SAR (measured) = 3.23 W/kg

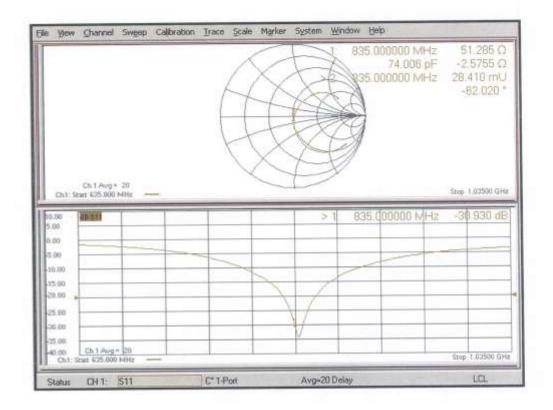


0 dB = 3.23 W/kg = 5.09 dBW/kg

Certificate No: D835V2-4d165\_Jul20

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## Impedance Measurement Plot for Head TSL





Report No: HCT-SR-2103-FC002

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





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Accreditation No.: SCS 0108

HCT (Dymstec) Certificate No: D1800V2-2d007\_Aug20 **CALIBRATION CERTIFICATE** D1800V2 - SN:2d007 Object 4 2010 1106 2020 1 10 6 Calibration procedure(s) QA CAL-05.V11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz Calibration date: August 26, 2020 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID# Cail Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 01-Apr-20 (No. 217-03100/03101) Apr-21 Power sensor NRP-Z91 SN: 103244 01-Apr-20 (No. 217-03100) Apr-21 Power sensor NRP-Z91 SN: 103245 01-Apr-20 (No. 217-03101) Apr-21 Reference 20 dB Attenuator SN: BH9394 (20k) 31-Mar-20 (No. 217-03106) Apr-21 Type-N mismatch combination SN: 310982 / 06327 31-Mar-20 (No. 217-03104) Apr-21 Reference Probe EX30V4 SN: 7349 29-Jun-20 (No. EX3-7349\_Jun20) Jun-21 DAE4 SN: 601 27-Dec-19 (No. DAE4-601\_Dec19) Dec-20 Secondary Standards Check Date (in house) Scheduled Check Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Feb-19) In house check: Oct-20 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-18) In house check: Oct-20 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-18) In house check: Oct-20 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-18) In house check: Oct-20 Network Analyzer Agilent E835BA SN: US41080477 31-Mar-14 (in house check Oct-19) In house check: Oct-20 Name Calibrated by: Led Klysner Laboratory Technician Approved by: Katia Pokovio Technical Manager Issued: August 27, 2020 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D1800V2-2d007 Aug20

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





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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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#### Glossary:

TSL

tissue simulating liquid

ConvF

sensitivity in TSL / NORM x,y,z

N/A

not applicable or not measured

## Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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: D1800V2-2d007 Aug20

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# Report No: HCT-SR-2103-FC002

## **Measurement Conditions**

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.4 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL

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

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

Certificate No: D1800V2-2d007\_Aug20

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## 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	
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Certificate No: D1800V2-2d007\_Aug20

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Report No: HCT-SR-2103-FC002

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

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

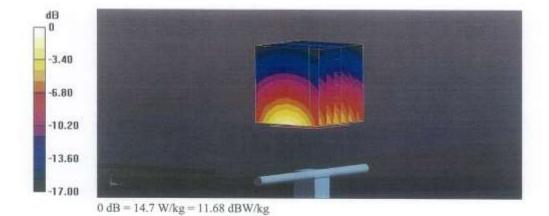
#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.38, 8.38, 8.38) @ 1800 MHz; Calibrated: 29.06,2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=Smm, dy=Smm, dz=Smm
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%

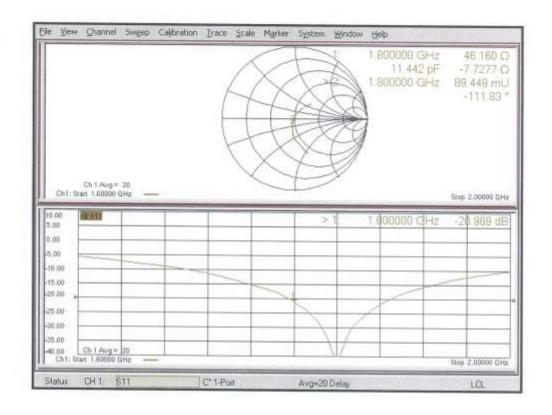
Maximum value of SAR (measured) = 14.7 W/kg



Certificate No: D1800V2-2d007\_Aug20

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## Impedance Measurement Plot for Head TSL



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Client HCT (Dymstec)

Certificate No: D1900V2-5d032\_Jan21

	ERTIFICATE	71	남당자	확인자
Object	D1900V2 - SN:5	여032 재	DL VIX 3	1345 M
Calibration procedure(s)	QA CAL-05 v11		1021,02,40	21.02-0
		edure for SAR Valida	ation Sources be	etween 0.7-3 GHz
Calibration date:	January 28, 202			
This calibration certificate docume The measurements and the uncer All calibrations have been conduct	rtainties with confidence p	robability are given on the f	ollowing pages and a	re part of the certificate.
Calibration Equipment used (M&T	E critical for calibration)			
	70			
rimary Standards	ID#	Cal Date (Certificate No.)	)	Scheduled Calibration
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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. 217-0310 01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310	00/03101) 00/0 01) 06)	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: BH9394 (20k)	01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 31-Mar-20 (No. 217-0310	00/03101) 00) 11) 06)	Apr-21 Apr-21 Apr-21 Apr-21
Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (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) 00) 11) 06) 04) 9_Dec20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
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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: 8H9394 (20k) SN: 310962 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 01-Apr-20 (No. 217-0310 31-Mar-20 (No. 217-0310 31-Mar-20 (No. 217-0310 28-Dec-20 (No. EX3-734 02-Nov-20 (No. DAE4-60	0003101) 00) 11) 06) 04) 9_Dec20) 01_Nov20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-21 Nov-21 Scheduled Check
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Certificate No: D1900V2-5d032\_Jan21

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Report No: HCT-SR-2103-FC002

#### 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:

- 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%.

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# XLA Report No: HCT-SR-2103-FC002

## **Measurement Conditions**

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

DASY5	V52.10.4
Advanced Extrapolation	
Modular Flat Phantom	
10 mm	with Spacer
dx, dy, dz = 5 mm	
1900 MHz ± 1 MHz	
	Advanced Extrapolation  Modular Flat Phantom  10 mm  dx, dy, dz = 5 mm

## 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 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL

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

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



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

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.4 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	72222VVV
Manufactured by	SPEAG

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

Date: 28.01.2021

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

#### DASY52 Configuration:

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

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

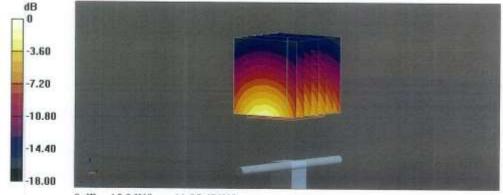
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 109.8 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.2 W/kg

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

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

Ratio of SAR at M2 to SAR at M1 = 54.9% Maximum value of SAR (measured) = 15.3 W/kg

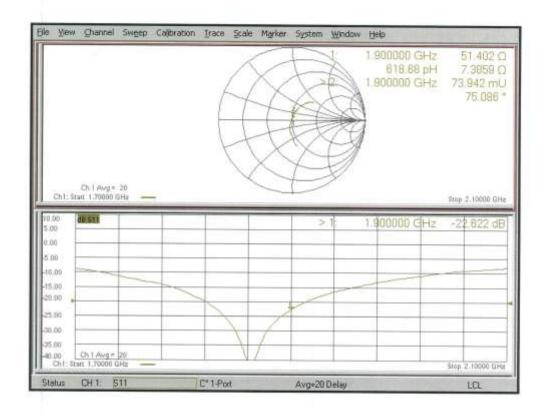


0 dB = 15.3 W/kg = 11.85 dBW/kg

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## Impedance Measurement Plot for Head TSL



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Report No: HCT-SR-2103-FC002

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





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

Accreditation No.: SCS 0108

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

Certificate No: D2450V2-1049\_Aug20 HCT (Dymstec)

	ERTIFICATE	E 2 1 1 1 7	위 인 자
20.000		XII /6	In
Object	D2450V2 - SN:10	049 41771 5 W / VIXI	2 48 141522
		9 4 610 /10.6	The state of the s
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	August 26, 2020		
	and and and		
The measurements and the uncertainty	ainties with confidence pr	onal standards, which realize the physical uni robability are given on the following pages an $y$ facility: environment temperature (22 $\pm$ 3)*0	d are part of the certificate.
rimary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
ower 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
	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Type-N mismatch combination			a sharper a
	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
Reference Probe EX3DV4	SN: 7349 SN: 601	29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19)	S18 (2000)
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	534 (1955) V		Jun-21
Reference Probe EX3DV4 DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Jun-21 Dec-20 Scheduled Check
Reference Probe EX3DV4  DAE4  Secondary Standards  Power meter E44198	SN: 601	27-Dec-19 (No. DAE4-801_Dec19) Check Date (in house)	Jun-21 Dec-20 Scheduled Check In house check: Oct-20
Reference Probe EX3DV4 DAE4 Secondary Standards	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)	Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A Power 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)	Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 601 ID W 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)	Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference Probe EX3DV4  DAE4  Secondary Standards  Power meter E4419B  Power sensor HP 8481A	SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	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)	Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilant E8358A	SN: 601 ID W 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-19)  Function	Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilant E8358A	SN: 601 ID W 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-19)  Function	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

Certificate No: D2450V2-1049 Aug20

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





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

Accreditation No.: SCS 0108

Report No: HCT-SR-2103-FC002

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

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# Report No: HCT-SR-2103-FC002

## **Measurement Conditions**

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

## SAR result with Head TSL

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

SAR averaged over 10 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)



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

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.5 Ω + 8.5 ΙΩ	
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

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Report No: HCT-SR-2103-FC002

## DASY5 Validation Report for Head TSL

Date: 26.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.74, 7.74, 7.74) @ 2450 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.7 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 25.5 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.06 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 51.3%
Maximum value of SAR (measured) = 21.4 W/kg

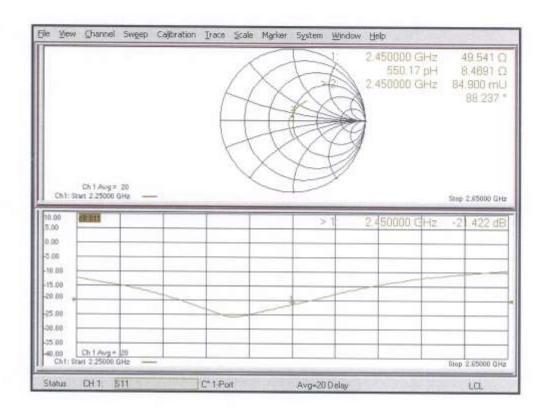


0 dB = 21.4 W/kg = 13.30 dBW/kg

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## Impedance Measurement Plot for Head TSL



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

## **Evaluation Condition**

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

## SAR result with SAM Head (Top ≅ C0)

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

## SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm3 (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>2</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)
SAD averaged aver 10 and 100 at 1511 at 701	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	CONCIDENT	

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Additional assessments outside the current scope of SCS 0108



Report No: HCT-SR-2103-FC002

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

Client HCT (Dymstec)





S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S 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: D2600V2-1015\_Aug20

The state of the s	ERTIFICATI	결 보 당 사	마 인 차
Object	D2600V2 - SN:10	역위/영영 5~ / 약경	The second secon
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	
Calibration date:	August 26, 2020		
This calibration certificate docume The measurements and the uncert	nts the traceability to national trainties with confidence process.	onal standards, which realize the physical uni rebability are given on the following pages an	its of measurements (SI). d are part of the certificate.
		y facility; environment temperature (22 $\pm$ 3)°C	C and humidity < 70%,
Calibration Equipment used (M&T)	E critical for calibration)		
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
	SN: 104778 SN: 103244	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100)	Apr-21 Apr-21
ower sensor NRP-Z91		그 아내는 아이를 잃어가면 하는 것이 없다면 이 사람이 되었다면 하지만 하지 않는데 하다 그 때문에 다른데 하는데 하다 다른데 하다 되었다면 하지만	Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	10.000
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103244 SN: 103245	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101)	Apr-21 Apr-21
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103244 SN: 103245 SN: BH9394 (20k)	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03100)	Apr-21 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: BH9394 (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
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: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03100) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE4-601_Dec19)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: BH9394 (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 Dec-20 Scheduled Check
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103244 SN: 103245 SN: BH9394 (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 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 meter E4419B	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 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)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 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 meter E4419B Power sensor HP 8481A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID# SN: GB39612475 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)	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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-08	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 801 ID# SN: GB38612475 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-18) 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-20
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: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 801 ID# SN: GB38612475 SN: US37292783 SN: MY41092317 SN: 100972	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun-20) 27-Dec-19 (No. DAE-4-601_Dec-19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)	Apr-21 Apr-21 Apr-21 Apr-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 meter E4419B Power sensor HP 8481A RF generator R&S SMT-08 Network Analyzer Agilent EB358A	SN: 103244 SN: 103245 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 801  ID#  SN: GB38512475 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) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun-20) 27-Dec-19 (No. DAE-4-601_Dec-19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)	Apr-21 Apr-21 Apr-21 Apr-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 meter E4419B Power sensor HP 8481A RF generator R&S SMT-08	SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 801 ID# SN: GB38612475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun-20) 27-Dec-19 (No. DAE-4-601_Dec-19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)	Apr-21 Apr-21 Apr-21 Apr-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 meter E4419B Power sensor HP 8481A RF generator R&S 5MT-08 Network Analyzer Agillent E8358A Calibrated by:	SN: 103244 SN: 103245 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 801  ID# SN: GB39612475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477  Name Leif Klysner	01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 29-Jun-20 (No. EX3-7349_Jun20) 27-Dec-19 (No. DAE-4-601_Dec-19)  Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19)  Function Laboratory Technician	Apr-21 Apr-21 Apr-21 Apr-21 Jun-21 Jun-21 Dec-20 Scheduled Check In house check: Oct-20
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Certificate No: D2600V2-1015\_Aug20

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Calibration Laboratory of Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

Report No: HCT-SR-2103-FC002

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

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Report No: HCT-SR-2103-FC002

#### Measurement Conditions

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

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

## Head TSL parameters

The following parameters and calculations were applied.

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

## SAR result with Head TSL

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

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

Certificate No: D2600V2-1015\_Aug20

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Report No: HCT-SR-2103-FC002

## 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

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Report No: HCT-SR-2103-FC002

### **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

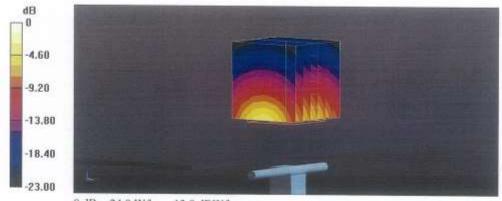
Peak SAR (extrapolated) = 28.6 W/kg

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

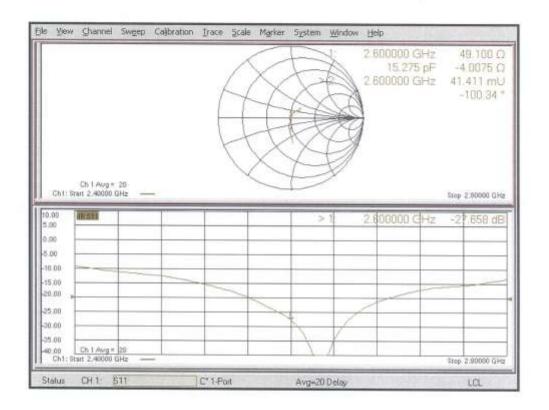


0 dB = 24.0 W/kg = 13.8 dBW/kg

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### Impedance Measurement Plot for Head TSL



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





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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

Certificate No: D5GHzV2-1253 Aug20

ALL DESIGNATION C.P.	RTIFICATE	21 답당자	확 인 자
ALIBITATION OF	HIIFICATE	2 76	19
Object	D5GHzV2 - SN:12	253 All 10 1 10 1 10 1 10 1 10 1 10 1 10 1	1010 1 19.6
	QA CAL-22.v5 Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	August 31, 2020		
he measurements and the uncerta	ainties with confidence pr	onal standards, which realize the physical unit robability are given on the following pages and ry facility: environment temperature (22 ± 3)°C	d are part of the certificate.
Calibration Equipment used (M&TE	critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	
Reference 20 dB Attenuator			Apr-21
Type-N mismatch combination	SN: 310962 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Type-N mismatch combination Reference Probe EX3DV4	SN: 310962 / 06327 SN: 3503	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19)	Apr-21 Dec-20
Type-N mismatch combination Reference Probe EX3DV4	SN: 310962 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 310962 / 06327 SN: 3503	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19)	Apr-21 Dec-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 310962 / 06327 SN: 3503 SN: 601	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198	SN: 310962 / 06327 SN: 3503 SN: 601	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 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)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
Reference 20 dB Aftenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power mater E44198 Power sensor HP 8481A Power sensor HP 8481A	SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB38612475	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A RF generator R&S SMT-06	SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A RF generator R&S SMT-06	SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Type-N mismatch combination Reference Probe EX30V4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A	SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08	SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 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)	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S \$AMT-08 Network Analyzer Agilent E8358A	SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41090477 Name	31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 27-Dec-19 (No. DAE4-601_Dec19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-19) Function	Apr-21 Dec-20 Dec-20 Scheduled Check In house check: Oct-20

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#### Calibration Laboratory of

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





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

Report No: HCT-SR-2103-FC002

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:

tissue simulating liquid TSL

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

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

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

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#### Measurement Conditions

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

	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)

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### 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		1999

#### 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)

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

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

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

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

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

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

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

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 ns
The state of the s	117 (47/2) 17

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

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Manufactured by	SPEAG

Certificate No: D5GHzV2-1253\_Aug20

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FCC ID: A3LNP345XLA Report No: HCT-SR-2103-FC002

### **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;  $\epsilon_f = 34.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>. Medium parameters used: f = 5600 MHz;  $\sigma = 4.83$  S/m;  $\epsilon_f = 34.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>.

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

Phantom section: Flat Section

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

#### DASY52 Configuration:

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

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

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

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

Peak SAR (extrapolated) = 27.8 W/kg

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

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

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

Maximum value of SAR (measured) = 18.3 W/kg

### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm

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

Reference Value = 77.49 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.3 W/kg

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

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

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

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

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

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

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

Peak SAR (extrapolated) = 31.8 W/kg

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

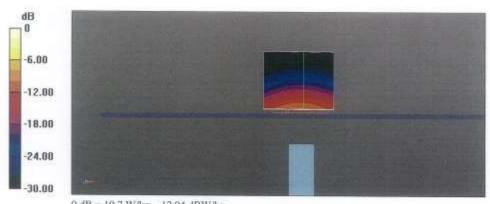
Smallest distance from peaks to all points 3 dB below = 7.4 mm

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

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

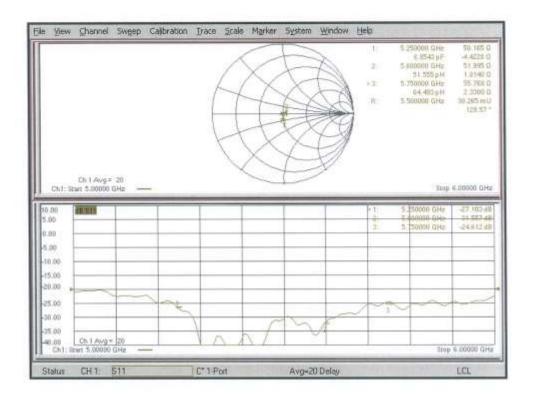
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0 dB = 19.7 W/kg = 12.94 dBW/kg

### Impedance Measurement Plot for Head TSL



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# 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.

#### 1. Power Reduction Verification for Main Ant

#### 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)

#### **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 distance - Rear					
Tissue simulating liquid	Moving toward phantom	Moving away from phantom				
	[mm]	[mm]				
750 MHz Tissue	16	17				
835 MHz Tissue	16	17				
1 750 MHz Tissue	16	17				
1 900MHz Tissue	16	17				
2 600MHz Tissue	16	17				

Distance Measurement verification for Proximity sensor





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

Mada	Distance to DUT Output power (dBm)									
Mode	21[mm]	20[mm]	19[mm]	18[mm]	17[mm]	16mm]	15[mm]	14[mm]	13[mm]	12[mm]
WCDMA B2	23.05	23.06	23.02	23.04	23.06	14.16	14.12	14.05	14.09	14.12
WCDMA B4	23.05	22.99	23.07	23.06	23.07	13.82	13.86	13.91	13.90	13.81
WCDMA B5	23.49	23.52	23.49	23.48	23.50	19.96	19.97	20.03	20.05	20.04
LTE Band 2	22.60	22.57	22.54	22.55	22.56	13.56	13.58	13.52	13.49	13.56
LTE Band 4	22.55	22.54	22.55	22.61	22.60	13.48	13.51	13.54	13.50	13.56
LTE Band 5	22.89	22.96	22.94	22.86	22.86	18.28	18.24	18.22	18.28	18.28
LTE Band 12	23.02	23.00	22.94	22.97	23.03	18.57	18.53	18.58	18.50	18.50
LTE Band 13	23.00	22.94	22.93	22.97	23.02	18.32	18.35	18.34	18.32	18.28
LTE Band 17	23.09	23.04	23.00	23.00	23.08	18.45	18.48	18.46	18.46	18.43
LTE Band 26	22.80	22.81	22.81	22.77	22.77	18.24	18.26	18.23	18.27	18.19
LTE Band 41	23.30	23.28	23.28	23.31	23.33	16.63	16.62	16.65	16.64	16.61
LTE Band 66	22.64	22.60	22.65	22.59	22.56	13.43	13.42	13.41	13.41	13.43

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

Mode	Distance to DUT Output power (dBm)									
Mode	13[mm]	14[mm]	15[mm]	16[mm]	17[mm]	18[mm]	19[mm]	20[mm]	21[mm]	22[mm]
WCDMA B2	14.17	14.19	14.19	14.20	14.19	23.05	23.05	23.07	23.08	23.09
WCDMA B4	13.83	13.85	13.86	13.84	13.86	23.05	23.07	23.08	23.08	23.06
WCDMA B5	19.98	20.00	20.00	20.01	19.99	23.51	23.52	23.52	23.52	23.49
LTE Band 2	13.56	13.57	13.59	13.58	13.60	22.65	22.61	22.61	22.64	22.61
LTE Band 4	13.48	13.50	13.49	13.50	13.49	22.58	22.59	22.60	22.57	22.60
LTE Band 5	18.29	18.28	18.29	18.33	18.31	22.90	22.92	22.90	22.93	22.91
LTE Band 12	18.61	18.61	18.60	18.60	18.59	23.05	23.05	23.04	23.02	23.07
LTE Band 13	18.36	18.32	18.36	18.36	18.32	23.02	23.00	23.00	23.03	23.03
LTE Band 17	18.45	18.50	18.50	18.45	18.48	23.10	23.10	23.14	23.09	23.14
LTE Band 26	18.25	18.25	18.25	18.26	18.27	22.83	22.80	22.83	22.80	22.80
LTE Band 41	16.67	16.63	16.65	16.64	16.67	23.33	23.33	23.31	23.32	23.33
LTE Band 66	13.46	13.45	13.44	13.46	13.43	22.69	22.64	22.64	22.68	22.66

Based on the most conservative measured triggering distance of 16mm, additional SAR measurements were required at 15mm from rear side for the above modes

### 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)

Proximity sensor is applied to the rear side of the laptop, there is no need for Tilt Angle Assessment of Proximity sensor.

### 1.4 Resulting test positions for SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for SAR [mm]
WWAN (WCDMA B2/B4/B5 /LTEB2/B4/B5/B12 /B13/B17/B26/B41/B66)	Rear	16	N/A	N/A	15

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 use conditions

### 2. Power reduction Verification for WLAN Ant 1

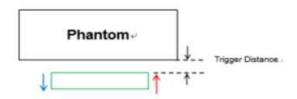
#### 2.1 Distance Verification Procedure

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)

#### 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 distance - Rear					
Tissue simulating liquid	Moving toward phantom [mm]	Moving away from phantom [mm]				
2450MHz Tissue	7	8				
5000MHz Tissue	7	8				

Distance Measurement verification for Proximity sensor





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

	Distance to DUT Output power (dBm)										
Mode	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm ]	3[mm ]	
2.4GHz 802.11b(7ch-11ch)	15.68	15.70	15.65	15.68	15.66	10.10	10.02	10.08	10.07	10.02	
2.4GHz 802.11g(2ch-11ch)	15.42	15.40	15.49	15.49	15.41	10.06	10.03	10.04	10.08	10.03	
2.4GHz 802.11n(2ch-11ch)	15.21	15.19	15.20	15.16	15.18	10.09	10.10	10.03	10.08	10.08	
2.4GHz 802.11ac(2ch-11ch)	15.16	15.15	15.17	15.21	15.15	10.05	10.12	10.08	10.09	10.05	
5 GHz 802.11a [BW 20]	15.23	15.17	15.27	15.26	15.21	10.13	10.10	10.05	10.13	10.07	
5 GHz 802.11n [BW 20]	14.19	14.19	14.18	14.16	14.20	10.07	10.07	10.07	10.11	10.12	
5 GHz 802.11n [BW 40]	13.10	13.15	13.15	13.16	13.14	10.10	10.07	10.15	10.11	10.13	
5 GHz 802.11ac [BW 20]	13.21	13.20	13.18	13.15	13.17	10.13	10.17	10.07	10.09	10.11	
5 GHz 802.11ac [BW 40]	12.12	12.15	12.09	12.15	12.14	10.10	10.13	10.12	10.09	10.18	
5 GHz 802.11ac [BW 80]	11.17	11.18	11.18	11.17	11.19	10.10	10.12	10.17	10.16	10.10	

Rear side - EUT Moving away (Release) from the Phantom

Mode		Distance to DUT Output power (dBm)											
Mode	4[mm]	5[mm]	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]			
2.4GHz 802.11b(7ch-11ch)	10.10	10.05	10.12	10.09	10.04	15.70	15.72	15.66	15.71	15.68			
2.4GHz 802.11g(2ch-11ch)	10.09	10.08	10.05	10.10	10.03	15.44	15.43	15.52	15.51	15.44			
2.4GHz 802.11n(2ch-11ch)	10.12	10.10	10.07	10.11	10.09	15.25	15.20	15.24	15.19	15.18			
2.4GHz 802.11ac(2ch-11ch)	10.07	10.12	10.08	10.11	10.07	15.17	15.16	15.21	15.24	15.16			
5 GHz 802.11a [BW 20]	10.15	10.11	10.05	10.15	10.10	15.27	15.18	15.28	15.30	15.22			
5 GHz 802.11n [BW 20]	10.09	10.11	10.10	10.13	10.12	14.24	14.23	14.19	14.18	14.21			
5 GHz 802.11n [BW 40]	10.11	10.08	10.17	10.15	10.17	13.12	13.18	13.16	13.21	13.14			
5 GHz 802.11ac [BW 20]	10.17	10.17	10.08	10.12	10.15	13.22	13.25	13.21	13.18	13.19			
5 GHz 802.11ac [BW 40]	10.11	10.13	10.14	10.10	10.18	12.13	12.19	12.12	12.17	12.19			
5 GHz 802.11ac [BW 80]	10.14	10.13	10.18	10.20	10.13	11.22	11.21	11.19	11.18	11.19			

Based on the most conservative measured triggering distance of 7mm, additional SAR measurements were required at 6mm from rear side for the above modes

### 2.2 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.

### 2.3 Proximity Sensor Tilt Angle Assessment

(KDB 616217 D04v01r02 §6.4)

Proximity sensor is applied to the rear side of the laptop, there is no need for Tilt Angle Assessment of Proximity sensor.

### 2.4 Resulting test positions for SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for SAR [mm]
WLAN(2.4GHz 802.11b(1-11ch)/ 802.11g(1-11ch)/802.11n(1-11ch)/ 802.11ac(1-11ch)/ 5GHz 802.11a[BW 20]/ 802.11n[BW 20]/ 802.11n[BW 40]/ 802.11ac[BW 20]/ 802.11ac[BW 40]/ 802.11ac[BW 80])	Rear	7	N/A	N/A	6

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 use conditions

### 3. Power reduction Verification for WLAN Ant 2

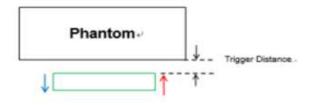
#### 3.1 Distance Verification Procedure

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)

#### **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 distance - Rear							
Tissue simulating liquid	Moving toward phantom [mm]	Moving away from phantom [mm]						
2 450MHz Tissue	10	11						
5 000MHz Tissue	10	11						

Distance Measurement verification for Proximity sensor



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

			Dis	tance to	DUT Outp	ut power	(dBm)			
Mode	15[mm] 14[mm] 13[mm] <sup>1</sup>		12[mm ]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm ]	6[mm ]	
2.4GHz 802.11b(7ch-11ch)	15.66	15.68	15.58	15.59	15.65	10.07	9.97	10.07	9.99	9.94
2.4GHz 802.11g(2ch-11ch)	15.36	15.40	15.46	15.45	15.36	10.05	10.01	9.96	10.03	10.01
2.4GHz 802.11n(2ch-11ch)	15.19	15.15	15.15	15.16	15.17	10.02	10.01	9.96	10.05	10.03
2.4GHz 802.11ac(2ch-11ch)	15.15	15.09	15.15	15.20	15.13	9.99	10.03	10.05	10.04	10.02
5 GHz 802.11a [BW 20]	15.22	15.13	15.26	15.22	15.18	10.04	10.08	9.98	10.05	9.99
5 GHz 802.11n [BW 20]	14.10	14.15	14.10	14.14	14.20	10.00	10.07	10.00	10.02	10.03
5 GHz 802.11n [BW 40]	13.05	13.10	13.08	13.06	13.10	10.07	10.03	10.09	10.03	10.07
5 GHz 802.11ac [BW 20]	13.18	13.13	13.17	13.09	13.13	10.05	10.16	10.03	10.02	10.05
5 GHz 802.11ac [BW 40]	12.05	12.14	12.03	12.10	12.11	10.08	10.09	10.06	10.04	10.12
5 GHz 802.11ac [BW 80]	11.10	11.18	11.10	11.07	11.13	10.06	10.03	10.10	10.12	10.09

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

Mode				Distanc	e to DUT	Output p	ower (dBı	n)		
Mode	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]
2.4GHz 802.11b(7ch-11ch)	10.12	10.09	10.15	10.10	10.07	15.71	15.74	15.67	15.74	15.72
2.4GHz 802.11g(2ch-11ch)	10.11	10.11	10.08	10.12	10.05	15.48	15.47	15.52	15.52	15.48
2.4GHz 802.11n(2ch-11ch)	10.15	10.11	10.08	10.16	10.13	15.26	15.21	15.26	15.24	15.23
2.4GHz 802.11ac(2ch-11ch)	10.12	10.13	10.12	10.14	10.09	15.21	15.18	15.22	15.26	15.19
5 GHz 802.11a [BW 20]	10.20	10.13	10.09	10.15	10.15	15.27	15.20	15.32	15.35	15.26
5 GHz 802.11n [BW 20]	10.12	10.13	10.12	10.18	10.15	14.28	14.25	14.21	14.21	14.24
5 GHz 802.11n [BW 40]	10.11	10.12	10.19	10.19	10.20	13.13	13.21	13.19	13.25	13.19
5 GHz 802.11ac [BW 20]	10.18	10.18	10.13	10.16	10.18	13.23	13.27	13.24	13.19	13.24
5 GHz 802.11ac [BW 40]	10.12	10.14	10.19	10.13	10.18	12.14	12.22	12.14	12.22	12.22
5 GHz 802.11ac [BW 80]	10.18	10.13	10.18	10.22	10.14	11.25	11.26	11.23	11.21	11.21

Based on the most conservative measured triggering distance of 10mm, additional SAR measurements were required at 9mm from rear side for the above modes

### 3.2 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.

### 3.3 Proximity Sensor Tilt Angle Assessment

(KDB 616217 D04v01r02 §6.4)

Proximity sensor is applied to the rear side of the laptop, there is no need for Tilt Angle Assessment of Proximity sensor.

### 3.4 Resulting test positions for SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for SAR [mm]
WLAN(2.4GHz 802.11b(1-11ch)/ 802.11g(1-11ch)/802.11n(1-11ch)/ 802.11ac(1-11ch)/ 5GHz 802.11a[BW 20]/ 802.11n[BW 20]/ 802.11n[BW 40]/ 802.11ac[BW 20]/ 802.11ac[BW 40]/ 802.11ac[BW 80])	Rear	10	N/A	N/A	9

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 use conditions



Report No: HCT-SR-2103-FC002

# **Appendix I.-DL CA Power Measurement**



### 1. LTE Uplink and 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.

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#### **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.
- 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.

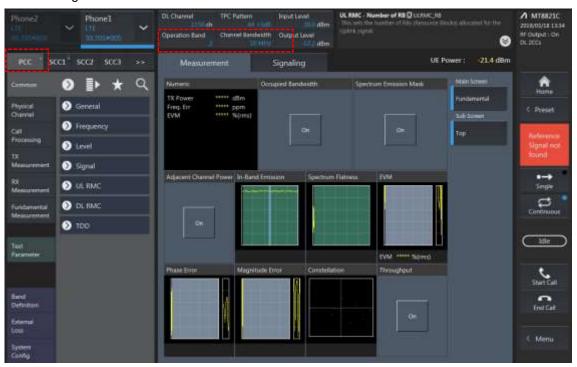
Base Station Simulator RF Connector Wireless
Device

Power Measurement setup

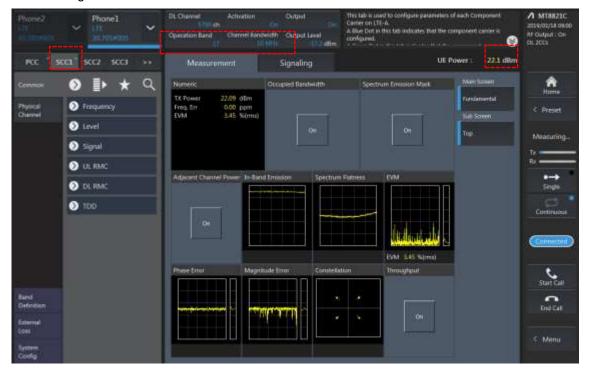


### LTE Down Link 2CA Call Setup

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



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





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

	PCC											SCC		Tx F		
Combination	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel		Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Carrier Tx	LTE Tx Power with DL CA Enabled(dBm)	Deviation
2C	2	20	18801	1870.1	801	1950.1	QPSK	1	0	2	20	999	1969.9	22.65	22.28	-0.37
2C	2	20	18999	1889.9	999	1969.9	QPSK	1	0	2	20	801	1950.1	22.65	22.44	-0.21
2A-2A	2	15	18675	1857.5	675	1937.5	QPSK	1	74	2	20	1100	1980	22.16	22.16	0.00
2A-2A	2	15	19125	1902.5	1125	1902.5	QPSK	1	74	2	20	700	1940	22.63	22.64	0.01
2A-13A	2	20	18900	1880	900	1960	QPSK	1	0	13	10	5230	751	22.65	22.37	-0.28
2A-13A	13	10	23230	782	5230	751	QPSK	1	24	2	20	900	1960	23.04	23.14	0.10
4A-13A	4	15	20175	1732.5	2175	2132.5	QPSK	1	0	13	10	5230	751	22.75	22.82	0.07
4A-13A	13	10	23230	782	5230	751	QPSK	1	24	4	20	2175	2132.5	23.04	23.15	0.11
5A-41A	5	10	20525	836.5	2525	881.5	QPSK	1	0	41	20	40620	25.93	22.97	23.03	0.06
41A-41A	41	15	39725	2503.5	39725	2503.5	QPSK	1	0	41	20	41490	2680	23.40	22.86	-0.54
41A-41A	41	20	41490	2680	41490	2680	QPSK	1	0	41	20	39750	2506	23.25	23.02	-0.23
66B	66	15	132047	1717.5	66511	2117.5	QPSK	1	74	66	5	66604	2126.8	22.62	22.69	0.07
66B	66	10	132622	1775	67086	2175	QPSK	1	0	66	10	67185	2184.9	22.17	22.23	0.06
66C	66	15	132047	1717.5	66511	2117.5	QPSK	1	74	66	20	66682	2134.6	22.62	22.62	0.00
66C	66	10	132622	1775	67086	2175	QPSK	1	0	66	20	66942	2160.6	22.17	22.21	0.04

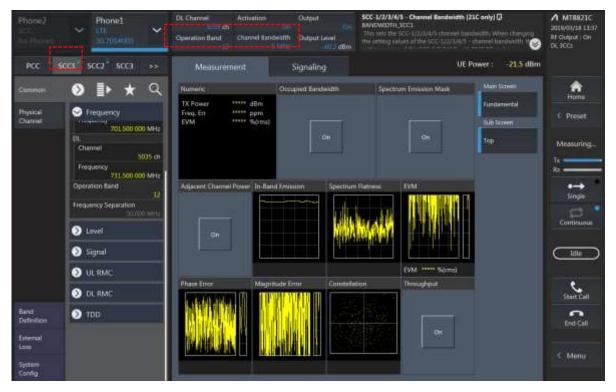


### LTE Down Link 3CA Call Setup

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



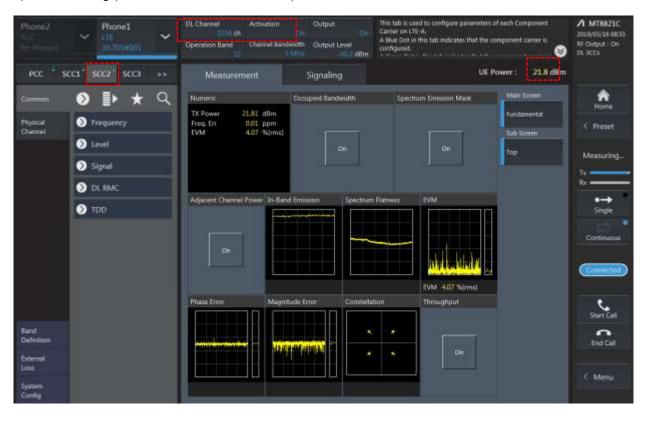
2) SCC1 Setting: Channel /RB/BW/Modulation





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





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# 3CA Downlink Carrier aggregation Maximum conducted Powers

	PCC									SCC				SCC		Tx F				
Combination	Band	BW	PCC UL Ch.	PCC UL Freq.	PCC DL Ch.	PCC DL Freq.	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled (dBm)	Deviation
2A-4A-5A	2	20	18900	1880	900	1960	QPSK	1	0	4	20	2175	2132.5	5	10	2525	881.5	22.65	22.36	-0.29
2A-4A-5A	4	15	20175	1732.5	2175	2132.5	QPSK	1	0	2	20	900	1960	5	10	2525	881.5	22.75	22.87	0.12
2A-4A-5A	5	10	20525	836.5	2525	881.5	QPSK	1	0	2	20	900	1960	4	20	2175	2132.5	22.97	23.02	0.05
2A-4A-12A	2	20	18900	1880	900	1960	QPSK	1	0	4	20	2175	2132.5	12	10	5095	737.5	22.65	22.44	-0.21
2A-4A-12A	4	15	20175	1732.5	2175	2132.5	QPSK	1	0	2	20	900	1960	12	10	5095	737.5	22.75	22.84	0.09
2A-4A-12A	12	5	23035	701.5	5035	731.5	QPSK	1	24	2	20	900	1960	4	20	2175	2132.5	23.16	23.22	0.06
2A-12A-66A	2	20	18900	1880	900	1960	QPSK	1	0	12	10	5095	737.5	66	20	66786	2145	22.65	22.38	-0.27
2A-12A-66A	12	5	23035	701.5	5035	731.5	QPSK	1	24	2	20	900	1960	66	20	66786	2145	23.16	23.23	0.07
2A-12A-66A	66	20	132572	1770	67036	2170	QPSK	1	0	2	20	900	1960	12	10	5095	737.5	22.68	22.35	-0.33
4A-4A-12A	4	15	20025	1717.5	2025	2117.5	QPSK	1	0	4	20	2300	2145	12	10	5095	737.5	22.68	22.78	0.10
4A-4A-12A	4	15	20325	1747.5	2325	2147.5	QPSK	1	0	4	20	2050	2120	12	10	5095	737.5	22.61	22.77	0.16
4A-4A-12A	12	5	23035	701.5	5035	731.5	QPSK	1	24	4	20	2050	2120	4	20	2300	2145	23.16	23.22	0.06
5A-66A-66A	5	10	20525	836.5	2525	881.5	QPSK	1	0	66	20	66536	2120	66	20	67036	2170	22.97	23.02	0.05
5A-66A-66A	66	20	132572	1770	67036	2170	QPSK	1	0	66	20	66536	2120	5	10	2525	881.5	22.68	22.33	-0.35
5A-66A-66A	66	15	132047	1717.5	66511	2117.5	QPSK	1	74	66	20	67036	2170	5	10	2525	881.5	22.62	22.68	0.06
66A-66A-12A	66	20	132572	1770	67036	2170	QPSK	1	0	66	20	66536	2120	12	10	5095	737.5	22.68	22.37	-0.31
66A-66A-12A	66	15	132047	1717.5	66511	2117.5	QPSK	1	74	66	20	67036	2170	12	10	5095	737.5	22.62	22.66	0.04
66A-66A-12A	12	5	23035	701.5	5035	731.5	QPSK	1	24	66	20	66536	2120	66	20	67036	2170	23.16	23.23	0.07
41A-41C	41	15	39725	2503.5	39725	2503.5	QPSK	1	0	41	20	41292	2660.2	41	20	41490	2680	23.40	22.50	-0.90
41A-41C	41	20	41490	2680	41490	2680	QPSK	1	0	41	20	41292	2660.2	41	20	39750	2506	23.25	23.02	-0.23
41D	41	15	39725	2503.5	39725	2503.5	QPSK	1	0	41	20	39896	2520.6	41	20	40094	2540.4	23.40	22.82	-0.58