



Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage

Servizio svizzero di taratura S Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

TSL

tissue simulating liquid

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

not applicable or not measured

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D3700V2-1004_Jun21

Page 2 of 7





Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3700 MHz ± 1 MHz 3800 MHz ± 1 MHz	

Head TSL parameters at 3700 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.7	3.12 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.8 ± 6 %	3.12 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		****

SAR result with Head TSL at 3700 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	67.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2,44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.3 W/kg ± 19.5 % (k=2)

Head TSL parameters at 3800 MHz

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.6	3.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.6 ± 6 %	3.20 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	1200

SAR result with Head TSL at 3800 MHz

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 19.5 % (k=2)

Certificate No: D3700V2-1004_Jun21





Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 3700 MHz

Impedance, transformed to feed point	48.0 Ω - 6.9 jΩ	
Return Loss	- 22.7 dB	

Antenna Parameters with Head TSL at 3800 MHz

Impedance, transformed to feed point	58.0 Ω - 4.9 μΩ	
Return Loss	- 21.2 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1,139 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	200-200
Manufactured by	SPEAG
	JI LAG

Certificate No: D3700V2-1004_Jun21

Page 4 of 7





DASY5 Validation Report for Head TSL

Date: 21.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1004

Communication System: UID 0 - CW; Frequency: 3700 MHz, Frequency: 3800 MHz Medium parameters used: f = 3700 MHz; $\sigma = 3.12$ S/m; $\epsilon_r = 36.8$; $\rho = 1000$ kg/m³, Medium parameters used: f = 3800 MHz; $\sigma = 3.20$ S/m; $\epsilon_r = 36.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.73, 7.73, 7.73) @ 3700 MHz, ConvF(7.73, 7.73, 7.73) @ 3800 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52,10.4(1527); SEMCAD X 14.6.14(7483)

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

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

Reference Value = 71.56 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 6.74 W/kg; SAR(10 g) = 2.44 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 74%

Maximum value of SAR (measured) = 13.0 W/kg

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3800MHz/Zoom Scan,

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

Reference Value = 68.51 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 6.57 W/kg; SAR(10 g) = 2.41 W/kg

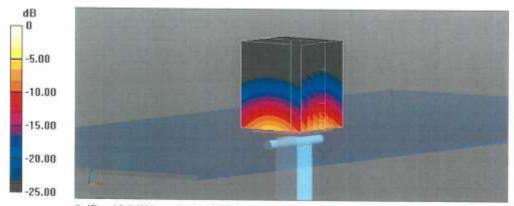
Smallest distance from peaks to all points 3 dB below = 8.2 mm

Ratio of SAR at M2 to SAR at M1 = 75%

Maximum value of SAR (measured) = 12.6 W/kg

Certificate No: D3700V2-1004_Jun21

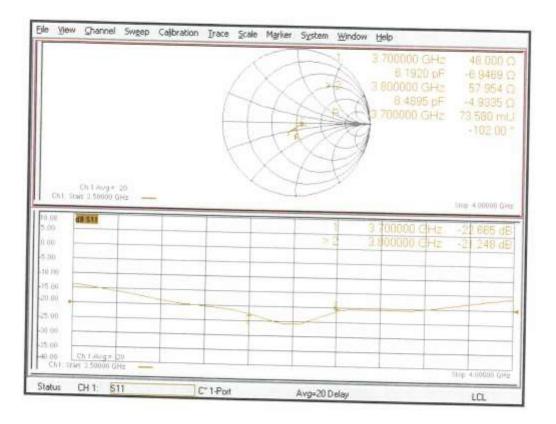




0 dB = 13.0 W/kg = 11.15 dBW/kg



Impedance Measurement Plot for Head TSL







5G Dipole Calibration Certificate

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

Client

CTTL (Auden)

Certificate No: D5GHzV2-1060 Jun21

Object	D5GHzV2 - SN:1	060	
nojeci	DJGHZVZ - SN. I	000	
alibration procedure(s)	QA CAL-22.v6		
	Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	June 22, 2021		
his calibration certificate documen	its the traceability to nati	ional standards, which realize the physical un	its of measurements (SI).
he measurements and the uncertainty	ainties with confidence p	robability are given on the following pages an	d are part of the certificate.
Washington beautiful and a second	distribution of the control of the c		2 and broaddles - 200
al calibrations have been conducte	id in the closed saborator	ry facility; environment temperature (22 ± 3)°(and humidity < 70%.
Calibration Equipment used (M&TE	critical for calibration)		
Primary Standards	ID N	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP	SN; 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Annual Communication of the State of the Sta	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
ower sensor NHP-Z91			
	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Power sensor NRP-Z91	SN: 103245 SN: BH9394 (20k)	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343)	Apr-22 Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: BH9394 (20k) SN: 310982 / 06327	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	Apr-22 Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3503, Dec20)	Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: BH9394 (20k) SN: 310982 / 06327	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	Apr-22 Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 8H9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3503_Dec-20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house)	Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check
Power sensor NRP-Z91 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198	SN: BH9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3503_Dec-20) 02-Nov-20 (No. DAE4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20)	Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Typo-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A	SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3503_Dec-20) 02-Nov-20 (No. DAE4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Typo-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A	SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EXS-3503_Dec-20) 02-Nov-20 (No. DAE4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SM1-06	SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EXS-3503_Dec-20) 02-Nov-20 (No. DAE4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20)	Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22
Power sensor NRP-ZB1 Reference 20 dB Attenuator Fypo-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: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EXS-3503_Dec-20) 02-Nov-20 (No. DAE4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22
Power sensor NRP-ZB1 Reference 20 dB Attenuator Fypo-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: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EXS-3503_Dec-20) 02-Nov-20 (No. DAE4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20)	Apr-22 Apr-22 Dec-21 Nov-21
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SM1-06 Network Analyzer Agilent E8358A	SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3503_Dec-20) 02-Nov-20 (No. DAE-4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-25
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attanuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: BH9394 (20k) SN: 310962 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US41080477 Name Michael Weber	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3503_Dec-20) 02-Nov-20 (No. DAE-4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20) Function Liaboratory Technician	Apr-82 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-25 In house check: Oct-25 In house check: Oct-25
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 Power sensor HP 8481A Reference Probe EX3DV4 Reference Probe EX3	SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3503_Dec-20) 02-Nov-20 (No. DAE-4-601_Nov-20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Apr-82 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22

Certificate No: D5GHzV2-1060_Jun21

Page 1 of 13





Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst Service suisse d'étalonnage

C Servicio svizzero di taratura
S Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

TSL

tissue simulating liquid

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D5GHzV2-1060_Jun21

Page 2 of 13



Head TSL parameters at 5250 MHz

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.59 mho/m ± 6 %
Head TSL temperature change during test	< 0.5.°C	1440	

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) "C	34.6 ± 6 %	4.64 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2,35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.2 W/kg ± 19.5 % (k=2)



Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5250 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mha/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.54 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		14000

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	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 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)





Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

The state of the s	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.3 ± 6 %	4.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	Carrier Control	

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	87.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 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	34.1 ± 8 %	4.95 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 ² (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.7 W/kg ± 19.5 % (k=2)



Head TSL parameters at 5750 MHz

The following parameters and calculations were applied

	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	33.9 ± 6 %	5.10 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		7200

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.8 ± 6 %	5.15 mho/m ± 8 %
Head TSL temperature change during test	< 0.5 °C		*****

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8,19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.1 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)





Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	47.6 Ω - 6.2 jΩ	
Return Loss	- 23.3 dB	

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	46.9 Ω - 4.8 jΩ	
Return Loss	- 24.5 dB	

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	46.2 Ω - 3.3 jΩ
Return Loss	- 25.6 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	49.1 Ω - 4.2 ϳΩ
Return Loss	- 27.3 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω + 0.4 j Ω	
Return Loss	- 28.4 dB	





Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	51.8 Ω - 0.8 jΩ	
Return Loss	- 34,3 dB	

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	50.9 Ω - 2.7 jΩ
Return Loss	- 31.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
encounted bottly forth directorly	1.201110

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

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

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

Additional EUT Data

Manufactured by	SPEAG	

Certificate No: D5GHzV2-1060_Jun21

Page 8 of 13





DASY5 Validation Report for Head TSL

Date: 22.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1060

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5250 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 4.54$ S/m; $\epsilon_t = 34.7$; $\rho = 1000$ kg/m³. Medium parameters used: f = 5250 MHz; $\sigma = 4.59 \text{ S/m}$; $\epsilon_r = 34.6$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: f = 5300 MHz; $\sigma = 4.64$ S/m; $\varepsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5500 MHz; $\sigma = 4.85$ S/m; $\varepsilon_r = 34.3$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5600 MHz; $\sigma = 4.95 \text{ S/m}$; $\varepsilon_r = 34.1$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: f = 5750 MHz; $\sigma = 5.1$ S/m; $\epsilon_r = 33.9$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.15 \text{ S/m}$; $\epsilon_r = 33.8$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.8, 5.8, 5.8) @ 5200 MHz, ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.49, 5.49, 5.49) @ 5300 MHz, ConvF(5.25, 5.25, 5.25) @ 5500 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

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

Reference Value = 78.84 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 28.2 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.29 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 69.1%

Maximum value of SAR (measured) = 18.5 W/kg

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 = 80.04 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.2 W/kg

SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.29 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 70.3%

Maximum value of SAR (measured) = 18.2 W/kg

Certificate No: D5GHzV2-1060_Jun21

Page 9 of 13