



#### **Measurement Conditions**

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

DASY Version	DASY52	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.

1	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.50 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.3 W/kg ± 19.5 % (k=2)

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# 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	34.8 ± 6 %	4.55 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# 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	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.1 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.25 W/kg

### 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	34.7 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.1 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.33 W/kg

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# Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.80 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.60 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.3 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.44 W/kg

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	34.3 ± 6 %	4.90 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	8.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.2 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.40 W/kg

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#### 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	34.1 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.4 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.31 W/kg

#### Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	5.10 mho/m ± 6 %
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	8.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 $\rm cm^3$ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 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 5200 MHz

Impedance, transformed to feed point	49.4 Ω - 6.5 jΩ
Return Loss	- 23.7 dB

### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	47.7 Ω - 5.5 jΩ	
Return Loss	- 24.3 dB	

#### Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	46.2 Ω - 3.2 jΩ
Return Loss	- 25.8 dB

#### Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.0 Ω - 3.1 jΩ	
Return Loss	- 30.1 dB	

# Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.6 Ω + 0.5 jΩ
Return Loss	- 29.2 dB

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

Impedance, transformed to feed point	51.9 Ω - 1.7 jΩ
Return Loss	- 32.1 dB

#### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	51.2 Ω - 3.2 jΩ	
Return Loss	- 29.5 dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.202 ns	
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

#### **Additional EUT Data**

Manufactured by	SPEAG





# DASY5 Validation Report for Head TSL

Date: 05.07.2022

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;  $\sigma = 4.50$  S/m;  $\varepsilon_r = 34.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5250 MHz;  $\sigma = 4.55$  S/m;  $\varepsilon_r = 34.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5300 MHz;  $\sigma = 4.60$  S/m;  $\varepsilon_r = 34.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma = 4.80$  S/m;  $\varepsilon_r = 34.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma = 4.80$  S/m;  $\varepsilon_r = 34.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5500 MHz;  $\sigma = 4.90$  S/m;  $\varepsilon_r = 34.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5750 MHz;  $\sigma = 5.05$  S/m;  $\varepsilon_r = 34.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used: f = 5800 MHz;  $\sigma = 5.10$  S/m;  $\varepsilon_r = 34.0$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Mez;  $\sigma = 5.10$  S/m;  $\varepsilon_r = 34.0$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 74.40 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 27.9 W/kg SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.26 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) = 17.6 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 = 75.86 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 27.1 W/kg SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.25 W/kg Smallest distance from peaks to all points 3 dB below = 6.8 mm Ratio of SAR at M2 to SAR at M1 = 69.8% Maximum value of SAR (measured) = 17.4 W/kg

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# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 77.09 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 28.9 W/kg SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.33 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 68.9% Maximum value of SAR (measured) = 18.3 W/kg

#### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 76.69 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 32.9 W/kg SAR(1 g) = 8.60 W/kg; SAR(10 g) = 2.44 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 66.4% Maximum value of SAR (measured) = 19.8 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 = 76.44 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 31.2 W/kg SAR(1 g) = 8.39 W/kg; SAR(10 g) = 2.40 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 67.3% Maximum value of SAR (measured) = 19.3 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 = 73.53 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 31.8 W/kg SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.31 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.4% Maximum value of SAR (measured) = 19.0 W/kg

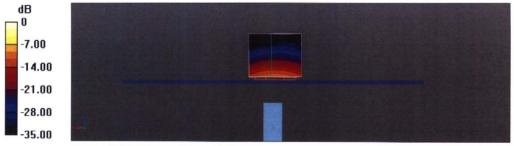
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 74.35 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 32.9 W/kg SAR(1 g) = 8.27 W/kg; SAR(10 g) = 2.34 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.2% Maximum value of SAR (measured) = 19.4 W/kg

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0 dB = 19.8 W/kg = 12.96 dBW/kg

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# Impedance Measurement Plot for Head TSL (5200, 5250, 5300, 5500, 5600 MHz)

4.7212 pF   -6.48     2:   5.250000 GHz   47.7     3:   5.300000 GHz   46.2     3:   5.300000 GHz   49.3     9:   3.333 pF   -3.13     5:   5.60000 GHz   53.5     13:   425 pH   472.38     10:00   11:   5.20000 GHz   23.83     5:00   12:   5.50000 GHz   24.23.89     0:00   11:   5.300000 GHz   24.23.83     0:00   11:   5.300000 GHz   24.23.83     0:00   12:   5.500000 GHz   24.33     5:   5.200000 GHz   24.33     5:   5.200000 GHz   24.33     5:   5.200000 GHz   24.33	e <u>V</u> iew	⊆hannel	Sweep	Calibration	Irace	Scale	Marker	System	Window	Help		
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# Impedance Measurement Plot for Head TSL (5300, 5500, 5600, 5750, 5800 MHz)

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										3:	5.300000 GHz	46.215 \$
						X	-	1-	X		9,3639 pF	-3.2069 0
						/	$\bigvee$	1-	112	4:	5.500000 GHz	49.978 0
						/ /	$\frown$	1	11-	5:	9.2370 pF	-3,1327 \$
					F	~/	X	X	K-1	5:	5.600000 GHz	53.576 0
					1	7	-1	XX	N	6:	13.425 pH 5.750000 GHz	472.39 mg 51.897 g
					1	1	(m	1-1	SXC	0.	16.469 pF	-1.6807 0
							1	E	201	>7:	5.800000 GHz	51.225 \$
					}	F	+	X	10	er.	8.6324 pF	-3.1788 0
						X	X	F	Y			
C		Ch 1 Avg = rt 5.00000		_				1			Stop	6.00000 GH:
	Ch1: Sta	nt 5.00000		_		_						6.00000 GH:
10.0	Ch1: Sta			_						3:	5.\$00000 GHz	-25.759 dE
10.0	Ch1: Sta	nt 5.00000		_						4:	5.200000 GHz 5.500000 GHz	-25.759 dE
10.0 5.00	0	nt 5.00000								4: 5:	5.300000 GHz 5.500000 GHz 5.600000 GHz	-25.759 dE 20.084 dE -29.163 dE
10.00 5.00 0.00	0 0	nt 5.00000								4:	5.300000 GHz 5.500000 GHz 5.800000 GHz 5.50000 GHz 5.750000 GHz	-25.759 dE -29.084 dE -29.163 dE -32.088 dE
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10.00 5.00 5.00 5.00 10.0 -15.0 -20.0	Ch1: Sta	nt 5.00000		-						4: 5: 6:	5.300000 GHz 5.500000 GHz 5.800000 GHz 5.50000 GHz 5.750000 GHz	-25.759 dE -29.084 dE -29.163 dE -32.088 dE
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# **ANNEX I** Accreditation Certificate

