

# **Appendix C**

# **Phantom Description**

Schmus & Panner Engin	eering AG	S	p	e	a	g	-
Zeughausstrasen 43, 80 Phone +41 1 245 9700, Info <b>G</b> epaug corn, hitp.//	Fax +41 1 245 9779						
	onformity / First Article I						_
item	SAM Twin Phantom \	/4.0	_				_
Type No.	QD 000 P40 C						
Series No	TP-1150 and higher				-		-
Property and the second s	the second se						_

Manufacturer SPEAG Zeughausstrasse 43 CH-8004 Zürich Switzerland

Tests

The series production process used allows the imitation to test of first articles. Complete tests were made on the pre-series Type No. OD 000 P40 AA. Serial No. TP-1001 and on the sones first article Type No. OD 000 P40 BA, Serial No. TP-1008. Certain parameters have been retested using further series items (salled samples) or are tested at each item.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the geometry according to the CAD model.	(TIS CAD File (*)	First article, Samples
Material thickness of shell	Compliant with the requirements according to the standards	2mm +/- 0.2mm in flat and specific areas of head section	First article, Samples, TP-1314 ff,
Material thickness at ERP	Compliant with the requirements according to the standards	6mm +/- 0.2mm at ERP	First article, All items
Material parameters	Dielectric parameters for required Mequancies	300 MHz - 0 GHz; Relative permittivity < 5. Loss tangent < 0.05	Material samples
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe technical Note for material compatibility.	DEGMBE based simulating liquids	Pre-series, First article, Material samples
Sagging	Compliant with the requirements according to the standards. Sagging of the flat section when filled with tissue simulating figuid	< 1% typical < 0.6% if filed with 155mm of HSL900 and without OUT below	Prototypes, Sample testing

Standards

- 日田四田の
- CENELEC EN 50361 IEEE Std 1528-2003
- IEC 62209 Part 1
- FCC OET Buildtin 65, Supplement C, Edition 01-01 The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standards [1] to [4]

07.07.2005



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# System Validation from Original Equipment Supplier

eughausstrasse 43, 8004 Zurich		all	
ccredited by the Swiss Accredital he Swiss Accreditation Service lultilateral Agreement for the re	is one of the signatorie	s to the EA	ccreditation No.: SCS 0108
lient SGS (Auden)			o: D6.5GHzV2-1006_Aug
CALIBRATION C	ERTIFICATE		
Object	D6.5GHzV2 - SN	:1006	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	dure for SAR Validation Sources	s between 3-10 GHz
Calibration date:	August 26, 2021		
The measurements and the uncer All calibrations have been conduc	tainties with confidence p ted in the closed laborato	ional standards, which realize the physical ur robability are given on the following pages ar ry facility: environment temperature $(22 \pm 3)^{\circ}$	nd are part of the certificate,
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



Schweizerischer Kalibrierdienst S Service suisse d'étalonnage

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Swiss Calibration Service

Accreditation No.: SCS 0108

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

# Glossary:

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

# Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.

### Additional Documentation:

b) DASY 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.
- 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 absorbed power density (APD): The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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: D6.5GHzV2-1006\_Aug21

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#### **Measurement Conditions**

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

DASY Version	DASY6	V16.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	5 mm	with Spacer
Zoom Scan Resolution	dx, dy = 3.4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	6500 MHz ± 1 MHz	

#### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	34.5	6.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.6 ± 6 %	6.11 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	29.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	291 W/kg ± 24.7 % (k=2)
	the second se	
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	5.39 W/kg

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# Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	45.7 Ω - 6.6 jΩ		
Return Loss	- 21.7 dB		

#### APD (Absorbed Power Density)

APD averaged over 1 cm <sup>2</sup>	Condition	
APD measured	100 mW input power	291 W/m <sup>2</sup>
APD measured	normalized to 1W	2910 W/m <sup>2</sup> ± 29.2 % (k=2)
ADD averaged aver 4 and	the second se	
APD averaged over 4 cm <sup>2</sup>	condition	
APD averaged over 4 cm <sup>2</sup> APD measured	condition 100 mW input power	132 W/m <sup>2</sup>

#### General Antenna Parameters and Design

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: D6.5GHzV2-1006\_Aug21

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#### **DASY6 Validation Report for Head TSL**

Measurement Report for D6.5GHz-1006, UID 0 -, Channel 6500 (6500.0MHz)

Name, Manufa	acturer Di	mensions	[mm] IM	E	DUT Typ	e	
D6.5GHz	1	6.0 x 6.0 x	300.0 SN	: 1006	-		
Exposure Cond	ditions						
Phantom	Position, Test	Band	Group,	Frequency	Conversion	TSL Cond.	TSL
Section, TSL	Distance [mm]		UID	[MHz]	Factor	[S/m]	Permittivity
Flat, HSL	5.00	Band	CW,	6500	5.75	6.11	33.6
Hardware Setu	un.						
Phantom	T:	SL		Probe, Calib	pration Date	DAF. Calib	ration Date
MFP V8.0 Cent	ter - 1182 H	BBL600-10	000V6		7405, 2020-12-30		08, 2021-06-24
Scan Setup				Measureme	ent Results		
			Zoom Scan				Zoom Scar
Grid Extents			22.0 x 22.0 x 22.0	Date		2	021-08-26, 10:54
Grid Steps [m			3.4 x 3.4 x 1.4	psSAR1g [\	N/Kg]		29.3
Sensor Surfac	ce [mm]		1.4	psSAR10g	[W/Kg]		5.39
Graded Grid			Yes	Power Drif	t [dB]		0.03
Grading Ratio	2		1.4	Power Sca	ling		Disabled
MAIA			N/A	Scaling Fac	tor [dB]		
Surface Detec			VMS + 6p	TSL Correc	tion		No correction
Scan Method			Measured	M2/M1 [%	]		50.3
					eak [mm]		



Certificate No: D6.5GHzV2-1006\_Aug21

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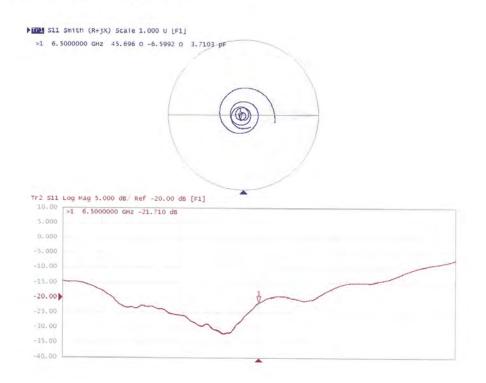
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#### Impedance Measurement Plot for Head TSL



Certificate No: D6.5GHzV2-1006\_Aug21

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accredited by the Swiss Accreditation the Swiss Accreditation Service in Aultilateral Agreement for the rec	is one of the signatorie	s to the EA	creditation No.: SCS 0108
Client SGS (Auden)		Certificate No	: D7GHzV2-1007_Aug2
CALIBRATION C	ERTIFICATE		
641-D			
Object	D7GHzV2 - SN:1	007	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	August 26, 2021		
		robability are given on the following pages an ry facility: environment temperature (22 $\pm$ 3)°C	
All calibrations have been conduct Calibration Equipment used (M&TE	ed in the closed laborato E critical for calibration)	ry facility: environment temperature (22 $\pm$ 3)°C	C and humidity < 70%.
All calibrations have been conduct Calibration Equipment used (M&TE Primary Standards	ed in the closed laborato		
All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91	ed in the closed laborator E critical for calibration)	ry facility: environment temperature (22 ± 3)°C Cal Date (Certificate No.)	C and humidity < 70%, Scheduled Calibration
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All calibrations have been conduct Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	ed in the closed laborator E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 103245 SN: 100967 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7405 SN: 908	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03293) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-7405_Dec20) 24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Jun-22 Scheduled Check
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# Glocean

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) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.

#### Additional Documentation:

b) DASY 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.
- 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 absorbed power density (APD): The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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	DASY6	V16.0	
Extrapolation	Advanced Extrapolation		
Phantom	Modular Flat Phantom		
Distance Dipole Center - TSL	5 mm	with Spacer	
Zoom Scan Resolution	dx, dy = 3.4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)	
Frequency	7000 MHz ± 1 MHz	a second s	

#### Head TSL parameters

The following parameters and calculations were applied.

the second se	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	33.9	6.65 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	32.7 ± 6 %	6.71 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	1.000	

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	27.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	275 W/kg ± 24.7 % (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	4.78 W/kg

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#### Appendix

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9 Ω - 3.8 jΩ
Return Loss	- 26.6 dB

#### APD (Absorbed Power Density)

APD averaged over 1 cm <sup>2</sup>	Condition		
APD measured	100 mW input power	274 W/m <sup>2</sup> 2740 W/m <sup>2</sup> ± 29.2 % (k=2)	
APD measured	normalized to 1W		
APD averaged over 4 cm <sup>2</sup>	condition		
APD averaged over 4 cm <sup>2</sup> APD measured	condition 100 mW input power	119 W/m <sup>2</sup>	

#### General Antenna Parameters and Design

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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# **DASY6 Validation Report for Head TSL**

Measurement Report for D7GHz-1007, UID 0 -, Channel 7000 (7000.0MHz)

Name, Manufacturer Dimensions [mm]		[mm] IN	IMEI DUT Type		9		
D7GHz 14.0 x 6.0 x 297.		297.0 SN	SN: 1007 -				
Exposure Cond	litions						
Phantom	Position, Test	Band	Group,	Frequency	Conversion	TSL Cond.	TSL
Section, TSL	Distance [mm]		UID	[MHz]	Factor	[S/m]	Permittivity
Flat, HSL	5.00	Band	CW,	7000	6.09	6.71	32.7
Hardware Setu	an						
Phantom	TS	5L		Probe, Calil	pration Date	DAE, Calib	ration Date
MFP V8.0 Cent	MFP V8.0 Center - 1182 HBBL600-10000V6		000V6	EX3DV4 - SN7405, 2020-12-30		DAE4 Sn908, 2021-06-24	
Scan Setup				Measureme	ent Results		
			Zoom Scan				Zoom Scan
Grid Extents	[mm]		22.0 x 22.0 x 22.0	Date		2	021-08-26, 14:14
Grid Steps [m	nm]		3.0 x 3.0 x 1.4	psSAR1g [\	W/Kg]		27.7
Sensor Surfac	ce [mm]		1.4	psSAR10g	[W/Kg]		4.78
Graded Grid			Yes	Power Drif	ft [dB]		0.05
Grading Ratio	0		1.4	Power Sca	ling		Disabled
MAIA			N/A	Scaling Fac	ctor [dB]		
Surface Deter	ction		VMS + 6p	TSL Correc	tion		No correction
Scan Method	E		Measured	M2/M1 [%	5]		46.9
				Dist 3dB P	eak [mm]		4.6



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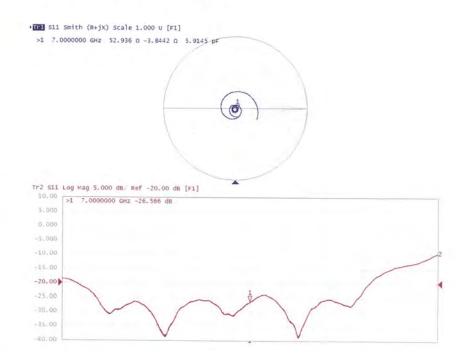
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#### Impedance Measurement Plot for Head TSL



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# - End of report -

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