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Appendix C

Phantom Description

Schmid & Partner Engineering AG Zeughausstlasse 43, 8004 Zurich, Switzerland Prione +41 44 245 9700, Fax +41 44 245 9779

Certificate of Conformity / First Article Inspection

info@speag.com, Mtp://www.speag.com

Item	Oval Flat Phantom ELI 5.0	
Type No	QD OVA 002 A	
Series No	1108 and higher	
Manufacturer	Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland	

Complete tests were made on the prototype units QD OVA 001 A, pre-series units QD OVA 001 B as well as on some series units QD OVA 001 B. Some tests are made on all series units QD OVA 002 A.

Test	Requirement	Details	Units tested
Shape	Internal dimensions, depth and sagging are compatible with standards	Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for t > 375 MHz	Prototypes
Material thickness	Bottom: 2 0mm +/- 0 2mm	dimension compliant with [3] for f > 800 MHz	all
Material parameters	rel. permittivity 2 - 5, loss tangent ≤ 0.05, at f ≤ 6 GHz	rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05	Material samples
Material resistivity	Compatibility with tissue simulating liquids	Compatible with SPEAG liquids. **	Phantoms, Material sample
Sagging	Sagging of the flat section in tolerance when filled with tissue simulating liquid.	within tolerance for filling height up to 155 mm	Prototypes, samples

Note: Compatibility restrictions apply certain liquid components mentioned in the standard, containing e.g. DGBE, DGMHE or Triton X-100, Observe technical note on material compatibility.

- OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
 IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific. Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement
- Techniques, December 2003

 [3] IEC 62209–1 ed 1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices Human models, instrumentation, and procedures Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)*, 2005-02-18

 [4] IEC 62209-2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted
- wireless communication devices Human models, instrumentation, and procedures Part 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)*, 2010-03-30.

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of body-worn SAR measurements and system performance checks as specified in [1 - 4] and further standards

25.7.2011

Signature / Stamp

Doc No 881 - QD OVA 002 A - A

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System Validation from Original Equipment Supplier

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





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Service suisse d'étalonnage
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Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client SGS-TW (Auden)

Certificate No: D2450V2-727_Apr21

	ERTIFICATE	•	
Object	D2450V2 - SN:72	27	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	April 14, 2021		
The measurements and the uncert	ainties with confidence p	ional standards, which realize the physical unrobability are given on the following pages and the standard standard for the standard stan	d are part of the certificate.
Calibration Equipment used (M&TE	12.0	Col Date (Colamont No.)	Scheduled Calibration
Primary Standards	ID#	Cal Date (Certificate No.)	
Power meter NRP Power sensor NRP-Z91	SN: 104778 SN: 103244	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291)	Apr-22 Apr-22
Power sensor NHP-Z91	SN: 103244 SN: 103245		Apr-22 Apr-22
Seules senses NIDD 704	1 DIV: 103245	09-Apr-21 (No. 217-03292)	Apr-22
	The second secon	00 Ame 24 (No. 247 02242)	Ans. 22
Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Reference 20 dB Attenuator Type-N mismatch combination	SN: BH9394 (20k) SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
	SN: BH9394 (20k)		The second second
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20)	Apr-22 Dec-21
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)	Apr-22 Dec-21 Nov-21 Scheduled Check
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	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house)	Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22
Reference 20 dB Attenuator Type-M mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20)	Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) 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)	Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) 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 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Reference 20 dB Attenuator Type-M 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 Name	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) 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)	Apr-22 Dec-21 Nov-21
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A PF generator R&S SMT-06	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_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) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21
Reference 20 dB Attenuator Type-M 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 Name	09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) 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)	Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21

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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
- 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	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	38.0 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13,8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.9 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.1 W/kg ± 16.5 % (k=2)

Body TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.4 ± 6 %	2.04 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.2 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	56.4 Ω + 2.9 jΩ	
Return Loss	- 23.6 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.9 \Omega + 4.8 j\Omega$	
Return Loss	- 25.9 dB	

General Antenna Parameters and Design

1.148 ns

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

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

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

Additional EUT Data

Manufactured by	SPEAG
manufactured by	OF LAG

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DASY5 Validation Report for Head TSL

Date: 14.04.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:727

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

Medium parameters used: f = 2450 MHz; $\sigma = 1.87$ S/m; $\varepsilon_r = 38.0$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 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)

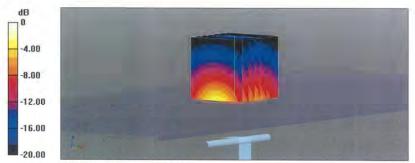
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 118.9 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 27.6 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.36 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 49.9% Maximum value of SAR (measured) = 22.8 W/kg



0 dB = 22.8 W/kg = 13.59 dBW/kg

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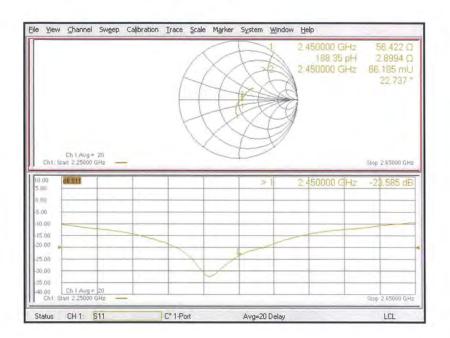
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 14.04.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:727

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

Medium parameters used: f = 2450 MHz; $\sigma = 2.04 \text{ S/m}$; $\varepsilon_r = 51.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12) @ 2450 MHz; Calibrated: 28.12.2020

· Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

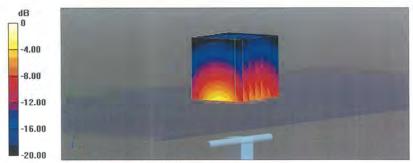
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 111.4 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 25.2 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.15 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 53.1% Maximum value of SAR (measured) = 21.5 W/kg



0 dB = 21.5 W/kg = 13.32 dBW/kg

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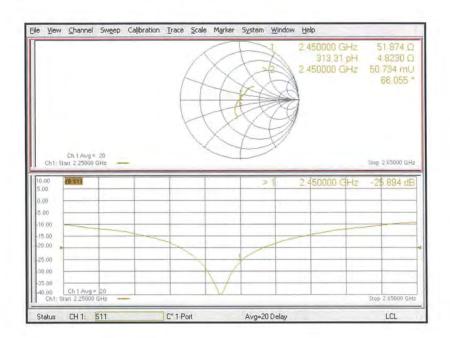
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Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-727 Apr21

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Client

SGS (Auden)

Certificate No: D5GHzV2-1023 Jan22

Object	D5GHzV2 - SN:1023		
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	edure for SAR Validation Sources	between 3-10 GHz
Calibration date:	January 27, 2022	2	
The measurements and the uncert	tainties with confidence p	onal standards, which realize the physical uni robability are given on the following pages an y facility: environment temperature (22 ± 3)°C	d are part of the certificate.
Calibration Equipment used (M&T)	E critical for calibration)		
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
	The second secon		
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
	SN: 104778 SN: 103244	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291)	
ower sensor NRP-Z91	2007	and the second s	Apr-22
ower sensor NRP-Z91 ower sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22 Apr-22
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103244 SN: 103245	09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292)	Apr-22 Apr-22 Apr-22
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103244 SN: 103245 SN: BH9394 (20k)	09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343)	Apr-22 Apr-22
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	09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	Apr-22 Apr-22 Apr-22 Apr-22
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: 3503	09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22
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: 3503 SN: 601	D9-Apr-21 (No. 217-03291) D9-Apr-21 (No. 217-03292) D9-Apr-21 (No. 217-03343) D9-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) D1-Nov-21 (No. DAE-4-601_Nov/21) Check Date (in house)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	D9-Apr-21 (No. 217-D3291) D9-Apr-21 (No. 217-D3292) D9-Apr-21 (No. 217-D3343) D9-Apr-21 (No. 217-D3344) 31-Dec-21 (No. EX3-3503_Dec21) D1-Nov-21 (No. DAE-4-601_Nov21) Check Date (in house) 30-Oct-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22
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: 3503 SN: 601	D9-Apr-21 (No. 217-03291) D9-Apr-21 (No. 217-03292) D9-Apr-21 (No. 217-03343) D9-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503, Dec-21) D1-Nov-21 (No. DAE-4-601_Nov21) Check Date (in house) 30-Cicl-14 (in house check Cicl-20) D7-Oct-15 (in house check Cicl-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22
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 Power sensor HP 8481A	SN: 103244 SN: 103245 SN: BHB394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID# SN: GB38512475 SN: US37292783	D9-Apr-21 (No. 217-D3291) D9-Apr-21 (No. 217-D3292) D9-Apr-21 (No. 217-D3343) D9-Apr-21 (No. 217-D3344) 31-Dec-21 (No. EX3-3503_Dec21) D1-Nov-21 (No. DAE-4-601_Nov21) Check Date (in house) 30-Oct-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Power sensor NRP-Z91 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 SMT-06	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41093315	09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03343) 19-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503, Dec-21) 01-Nov-21 (No. DAE4-601_Nov-21) 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 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
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 PF generator R&S SMT-06	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100672	D9-Apr-21 (No. 217-03291) D9-Apr-21 (No. 217-03292) D9-Apr-21 (No. 217-03343) D9-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503, Dec21) D1-Nov-21 (No. DAE-4-601_Nov21) 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) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22
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 Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agitent E8358A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41060477	D9-Apr-21 (No. 217-03291) D9-Apr-21 (No. 217-03292) D9-Apr-21 (No. 217-03343) D9-Apr-21 (No. 217-03343) 31-Dec-21 (No. EX3-3503, Dec21) D1-Nov-21 (No. EX3-3503, Dec21) D1-Nov-21 (No. DAE-4-601_Nov21) Check Date (in house) 30-Cct-14 (in house check Cct-20) 07-Oct-15 (in house check Cct-20) 07-Oct-15 (in house check Cct-20) 15-Jun 15 (in house check Cct-20) T-Mar-14 (in house check Cct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
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 Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agitent E8358A	SN: 103244 SN: 103245 SN: BH8394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB38512475 SN: US37292783 SN: MY41093315 SN: 100672 SN: US41080477	D9-Apr-21 (No. 217-03291) D9-Apr-21 (No. 217-03292) D9-Apr-21 (No. 217-03343) D9-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503, Dec21) D1-Nov-21 (No. DAE-4-601_Nov21) 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) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8491A Power sensor HP 8491A RF generator R&S SMT-06 Network Analyzer Agilient E8358A Calibrated by:	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41060477	D9-Apr-21 (No. 217-03291) D9-Apr-21 (No. 217-03292) D9-Apr-21 (No. 217-03343) D9-Apr-21 (No. 217-03343) 31-Dec-21 (No. EX3-3503, Dec21) D1-Nov-21 (No. EX3-3503, Dec21) D1-Nov-21 (No. DAE-4-601_Nov21) Check Date (in house) 30-Cct-14 (in house check Cct-20) 07-Oct-15 (in house check Cct-20) 07-Oct-15 (in house check Cct-20) 15-Jun 15 (in house check Cct-20) T-Mar-14 (in house check Cct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22

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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) 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.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). 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 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	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	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34,9 ± 6 %	4.52 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 ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (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)

Head TSL parameters at 5600 MHz

	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	34.4 ± 6 %	4.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-	

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

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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	34.2 ± 6 %	5.02 mho/m ± 6 %
Head TSL temperature change during test	< 0,5 °C		

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	8.17 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	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1023 Jan22

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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	52.0 Ω − 5.2 jΩ	
Return Loss	- 25.3 dB	

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.7 Ω + 0.2 μΩ
Return Loss	-27.0 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	57.2 Ω + 2.1 JΩ
Return Loss	-23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1,197 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
-----------------	-------

Certificate No: D5GHzV2-1023 Jan22

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DASY5 Validation Report for Head TSL

Date: 27.01,2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1023

Communication System: UID 0 - CW: Frequency: 5250 MHz, Frequency: 5600 MHz,

Frequency: 5750 MHz

Medium parameters used: f = 5250 MHz; $\sigma = 4.52$ S/m; $\varepsilon_r = 34.9$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5600 MHz; $\sigma = 4.87$ S/m; $\varepsilon_r = 34.4$; $\rho = 1000$ kg/m³. Medium parameters used: f = 5750 MHz; $\sigma = 5.02$ S/m; $\varepsilon_r = 34.2$; $\rho = 1000$ kg/m³

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: 31,12,2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated; 01.11.2021
- 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=5250 MHz/Zoom Scan,

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

Reference Value = 76.83 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 8.16 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 = 70.7%

Maximum value of SAR (measured) = 18.6 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 = 77.04 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 8.51 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 = 68%

Maximum value of SAR (measured) = 20.1 W/kg

Certificate No: D5GHzV2-1023 Jan22

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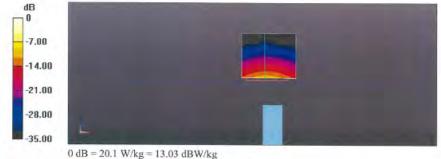


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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 74.27 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 31.8 W/kg SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.31 W/kgSmallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 66.3% Maximum value of SAR (measured) = 19.8 W/kg



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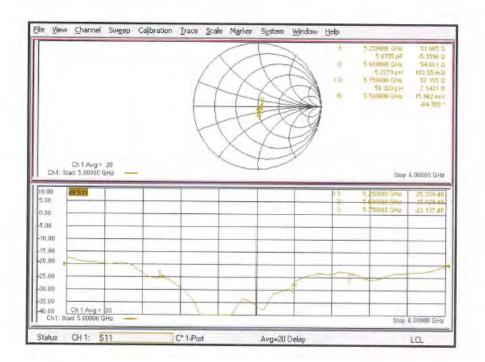
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Impedance Measurement Plot for Head TSL



Certificate No: D5GHzV2-1023_Jan22

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





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SGS (Auden)

Certificate No: D6.5GHzV2-1006_Aug21

Object	D6.5GHzV2 - SN	1:1006	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	adure for SAR Validation Sources	between 3-10 GHz
Calibration date:	August 26, 2021		
The measurements and the uncert	ainties with confidence p	ional standards, which realize the physical un robability are given on the following pages an	d are part of the certificate.
Calibration Equipment used (M&TE		ry facility: environment temperature (22 ± 3)°(and numidity < 70%.
Primary Standards	I ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
	SN: 100967	08-Apr-21 (No. 217-03293)	Apr-22
		any this extraocool	May an
Power sensor R&S NRP33T	Control Control	09-Apr-21 (No. 217-03343)	Apr. 22
Power sensor R&S NRP33T Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination	SN: BH9394 (20k) SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: BH9394 (20k)	The state of the s	
Power sensor NRP-Z81 Power sensor R8S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7405	09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-7405_Dec20)	Apr-22 Dec-21
Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7405 SN: 908	09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-7405_Dec20) 24-Jun-21 (No. DAE4-908_Jun21)	Apr-22 Dec-21 Jun-22 Scheduled Check
Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards. RF generator Anapico APSIN20G	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7405 SN: 908	09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-7405, Dec20) 24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house)	Apr-22 Dec-21 Jun-22 Scheduled Check In house check: Dec-21
Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7405 SN: 908 ID # SN: 669	09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX2-7405, Dec20) 24-Jun-21 (No. DAE4-908_fun21) Check Date (in house) 28-Mar-17 (in house check Dec-18) 10-May-12 (in house check Dec-18)	Apr-22 Dec-21 Jun-22 Scheduled Check In house check: Dec-21 In house check: Dec-21
Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator Anapico APSIN20G Network Analyzer R&S ZVL13	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7405 SN: 908 ID ii SN: 669 SN: 101083	09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-7405_Dec20) 24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house) 28-Mar-17 (in house check Dec-18)	Apr-22 Dec-21 Jun-22 Scheduled Check In house check: Dec-21
Power sensor R&S NRP33T Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards. RF generator Anapico APSIN20G	SN: BH9394 (20k) SN: 310982 / 06327 SN: 7405 SN: 908 ID # SN: 669 SN: 101083	09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-7405, Dec20) 24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house) 28-Mar-17 (in house check Dec-18) 10-May-12 (in house check Dec-18) Function	Apr-22 Dec-21 Jun-22 Scheduled Check In house check: Dec-21 In house check: Dec-21

Certificate No: D6.5GHzV2-1006_Aug21

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Swiss Calibration Service Accreditation No.: SCS 0108

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Glossary:

tissue simulating liquid TSL 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.
- SAH resun.

 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 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 follow ing 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	464	-

SAR result with Head TSL

SAR averaged over 1 cm ³ (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)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
CAR	The second secon	
SAR measured	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 Ω
Return Loss	-21.7 dB

APD (Absorbed Power Density)

APD averaged over 1 cm ²	Condition	
APD measured	100 mW input power	291 W/m²
APD measured	normalized to 1W	2910 W/m ² ± 29.2 % (k=2)
APD averaged over 4 cm ²	condition	
APD measured	100 mW input power	132 W/m ²
1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		

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

Name, Manuf	acturer Di	mensions	[mm]	IMEI	DUT Typ	e	
D6.5GHz	1	6.0 x 6.0 x	300.0	SN: 1006	-		
Exposure Cond	ditions						
Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz]	Conversion Factor	TSL Cond. [S/m]	TSL Permittivity
Flat, HSL	5.00	Band	CW,	6500	5.75	6.11	33.6
Hardware Set	up TS	SL		Probe, Cali	bration Date	DAE Calib	oration Date
MFP V8.0 Cent	ter - 1182 H	BBL600-10	000V6		N7405, 2020-12-30		08, 2021-06-24
Scan Setup				Measureme	ent Results		
			Zoom Sci	an			Zoom Scar
Grid Extents	[mm]		22.0 x 22.0 x 22			2021-08-26, 10:5	
Grid Steps [m			3.4 × 3.4 × 1	.4 psSAR1g[W/Kg]		29.3
Sensor Surface	e [mm]		1	.4 psSAR10g	[W/Kg]		5.39
Graded Grid			Y	es Power Dri	ft [dB]		0.03
Grading Ratio)		1	.4 Power Sca	ling		Disabled
MAIA				/A Scaling Fa	ctor [dB]		
Surface Deter			VMS +		111011		No correction
Scan Method			Measure				50.3
				Dist 3dB P	eak [mm]		4.8



Certificate No: D6.5GHzV2-1006_Aug21

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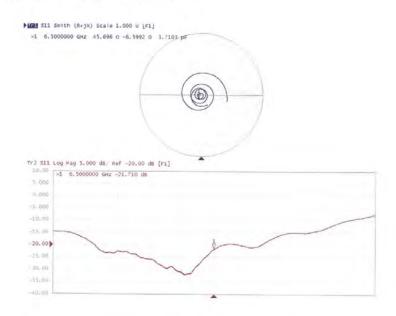
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Impedance Measurement Plot for Head TSL



Certificate No: D6.5GHzV2-1006_Aug21

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Accreditation No.: SCS 0108

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SGS (Auden)

Certificate No: D7GHzV2-1007_Aug21

	ERTIFICATE		
Object	D7GHzV2 - SN:1	007	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	edure for SAR Validation Sources	between 3-10 GHz
Calibration date:	August 26, 2021	ne e	
The measurements and the uncert	ainties with confidence p	ional standards, which realize the physical univerbability are given on the following pages an ry facility: environment temperature (22 ± 3)°C	d are part of the certificate.
Calibration Equipment used (M&TE			, , , , , , , , , , , , , , , , , , , ,
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Power sensor R&S NRP33T	SN: 100987	08-Apr-21 (No. 217-03293)	Apr-22
	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Reference 20 dB Attenuator	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
			Dec-21
Type-N mismatch combination	SN: 7406	30-Dec-20 (No. EX3-7405 Dec20)	
Type-N mismatch combination Reference Probe EX3DV4	SN: 7405 SN: 908	30-Dec-20 (No. EX3-7405_Dec20) 24-Jun-21 (No. DAE4-908_Jun21)	Jun-22
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	2000		7.7.00
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator Anapico APSIN20G	SN: 908	24-Jun-21 (No. DAE4-908 Jun21)	Jun-22 Scheduled Check
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator Anapico APSIN20G	SN: 908	24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house)	Jun-22 Scheduled Check In house check: Dec-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 908 ID # SN: 669 SN: 101093	24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house) 28-Mar-17 (in house check Dec-18) 10-May-12 (in house check Dec-18)	Jun-22 Scheduled Check In house check: Dec-21 In house check: Dec-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator Anapico APSIN20G Notwork Analyzer R&S ZVL13	SN: 908 ID # SN: 669 SN: 101093	24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house) 28-Mar-17 (in house check Dec-18) 10-May-12 (in house check Dec-18) Function	Jun-22 Scheduled Check In house check: Dec-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator Anapico APSIN20G Notwork Analyzer R&S ZVL13	SN: 908 ID # SN: 669 SN: 101093	24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house) 28-Mar-17 (in house check Dec-18) 10-May-12 (in house check Dec-18)	Jun-22 Scheduled Check In house check: Dec-21 In house check: Dec-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards RF generator Anapico APSIN20G	SN: 908 ID # SN: 669 SN: 101093	24-Jun-21 (No. DAE4-908_Jun21) Check Date (in house) 28-Mar-17 (in house check Dec-18) 10-May-12 (in house check Dec-18) Function	Jun-22 Scheduled Check In house check: Dec-21 In house check: Dec-21

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Certificate No: D7GHzV2-1007_Aug21



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





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Accreditation No.: SCS 0108

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Glossary:

TSL tissue simulating liquid ConvF sensitivity in TSL / NORM x,y,z 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
- 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: D7GHzV2-1007_Aug21

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Measurement Conditions

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	

Head TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	33.9	6,65 mha/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	***	i needer

SAR result with Head TSL

SAR averaged over 1 cm3 (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 ³ (10 g) of Head TSI	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL	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 ²	Condition	
APD measured	100 mW input power	274 W/m ²
APD measured	normalized to 1W	2740 W/m ² ± 29.2 % (k=2)
APD averaged over 4 cm ³	condition	
APD averaged over 4 cm ³ APD measured	condition 100 mW input power	119 W/m ²

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, Manufa	acturer Di	mensions	[mm] IN	1EI	DUT Typ	B	
D7GHz	14	4.0 x 6.0 x	297.0 St	1: 1007	-		
Exposure Cond	ditions						
Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz]	Conversion Factor	TSL Cond. [S/m]	TSL Permittivity
Flat, HSL	5.00	Band	cw,	7000	6.09	6.71	32.7
Hardware Set						DAT CARL	water Date
Phantom MFP V8.0 Cent	TS	BBL600-10	00001/6	Probe, Calibration Date EX3DV4 - SN7405, 2020-12-30		DAE, Calibration Date DAE4 Sn908, 2021-06-24	
VIFF VO.U CEIII	(e) - 1102 H	DDL000-10	000000	EN3D44-3	17403, 2020-12-30	DAL4 SIIS	00, 2021-00-24
Scan Setup				Measureme	ent Results		
			Zoom Scan				Zoom Sca
Grid Extents	[mm]		22.0 x 22.0 x 22.0	Date		2	021-08-26, 14:1
Grid Steps [m	nm]		3.0 x 3.0 x 1.4	psSAR1g [W/Kg]		27.
Sensor Surface	ce [mm]		1.4				4.7
Graded Grid			Yes				0.0
Grading Ratio	9		1.4				Disable
MAIA			N/A				
Surface Dete	ction		VMS + 6p	TSL Correc	tion		No correctio
Scan Method			Measured	M2/M1 [9	6]		46.

Dist 3dB Peak [mm]



Certificate No: D7GHzV2-1007_Aug21

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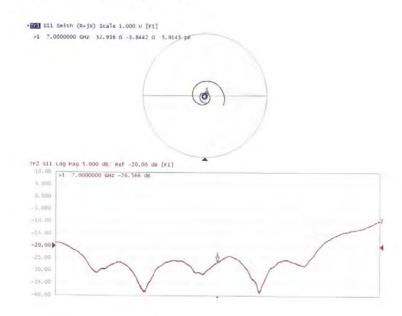
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Impedance Measurement Plot for Head TSL



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SGS (Auden)

Accreditation No.: SCS 0108

Certificate No: 5G-Veri10-1021_Jan22 **CALIBRATION CERTIFICATE** 5G Verification Source 10 GHz - SN: 1021 QA CAL-45.v3 Calibration procedure(s) Calibration procedure for sources in air above 6 GHz January 24, 2022 Calibration date: This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID# Cal Date (Certificate No.) Scheduled Calibration 2021-12-21(No. EUmmWV3-9374_Dec21) 2021-06-25 (No. DAE4ip-1602_Jun21) Reference Probe EUmmWV3 SN: 9374 DAE4ip SN: 1602 Jun-22 Secondary Standards ID# Check Date (in house) Scheduled Check Function Calibrated by: Leif Klysner Laboratory Technician Approved by: Sven Kühn Deputy Manager Issued: January 26, 2022 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: 5G-Veri10-1021 Jan22

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Glossarv

CW

Continuous wave

Calibration is Performed According to the Following Standards

- Internal procedure QA CAL-45-5Gsources
- IEC TR 63170 ED1, "Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz", January 2018

Methods Applied and Interpretation of Parameters

- Coordinate System: z-axis in the waveguide horn boresight, x-axis is in the direction of the E-field, y-axis normal to the others in the field scanning plane parallel to the horn flare and
- Measurement Conditions: (1) 10 GHz: The radiated power is the forward power to the horn antenna minus ohmic and mismatch loss. The forward power is measured prior and after the measurement with a power sensor. During the measurements, the horn is directly connected to the cable and the antenna ohmic and mismatch losses are determined by farfield measurements. (2) 30, 45, 60 and 90 GHz. The verification sources are switched on for at least 30 minutes. Absorbers are used around the probe cub and at the ceiling to minimize
- Horn Positioning: The waveguide horn is mounted vertically on the flange of the waveguide source to allow vertical positioning of the EUmmW probe during the scan. The plane is parallel to the phantom surface. Probe distance is verified using mechanical gauges positioned on the flare of the horn.
- E- field distribution: E field is measured in two x-y-plane (10mm, 10mm + $\lambda/4$) with a vectorial E-field probe. The E-field value stated as calibration value represents the E-fieldmaxima and the averaged (1cm2 and 4cm2) power density values at 10mm in front of the
- Field polarization: Above the open horn, linear polarization of the field is expected. This is verified graphically in the field representation.

Calibrated Quantity

Local peak E-field (V/m) and average of peak spatial components of the poynting vector (W/m²) averaged over the surface area of 1 cm² and 4cm² at the nominal operational frequency of the verification source. Both square and circular averaging results are listed.

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: 5G-Veri10-1021_Jan22

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Measurement Conditions

DASY Version	cDASY6 Module mmWave	V2.4
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
XY Scan Resolution	dx, dy = 7.5 mm	
Number of measured planes	2 (10mm, 10mm + λ/4)	
Frequency	10 GHz ± 10 MHz	

Calibration Parameters, 10 GHz

Circular Averaging

Distance Horn Aperture to Measured Plane	Prad¹ (mW)	Max E-field (V/m)		Avg Power Density Avg (psPDn+, psPDiot+, psPDmod+) (W/m²) 1 cm² 4 cm²		Uncertainty (k = 2)
10 mm	86.1	148	1.27 dB	55.2	51.7	1.28 dB

Distance Horn Aperture to Measured Plane	Prad' Ma (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m²)		Uncertainty (k = 2)
				1 cm ²	4 cm ²	
10 mm	86.1	148	1.27 dB	55.2	51.5	1.28 dB

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¹ Assessed ohmic and mismatch loss plus numerical offset: 0.55 dB



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DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

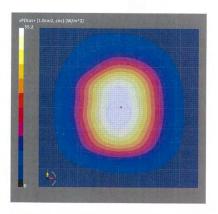
Measurenne...

Device under Test Properties

Device, Manufacturer

Dimensions [mm]

100.0 x 100.0 x 172.0 IMEI DUT Type SN: 1021 **Exposure Conditions** Position, Test Distance Band Frequency [MHz], Channel Number Conversion Factor 10.0 mm Validation band CW 10000.0, 1.0 Hardware Setup Probe, Calibration Date EUmmWV3 - SN9374_F1-55GHz, 2021-12-21 Medium DAE, Calibration Date mmWave Phantom - 1002 DAE4ip Sn1602, 2021-06-25 Scan Setup Measurement Results 5G Scan Grid Extents [mm] Grid Steps [lambda] Sensor Surface [mm] MAIA 5G Scan 2022-01-24, 11:01 1.00 55.0 55.2 55.4 148 0.01 120.0 x 120.0 0.25 x 0.25 Avg. Area [cm²] psPDn+ [W/m²] psPDtot+ [W/m²] psPDmod+ [W/m²] 10.0 MAIA not used E_{max} [V/m] Power Drift [dB]



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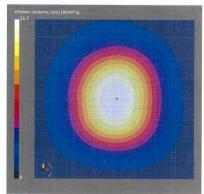
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DASY Report Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz) Device under Test Properties Name, Manufacturer Dimensions [mm] 5G Verification Source 10 GHz 100.0 x 100.0 x 172.0 IME **DUT Type Exposure Conditions** Position, Test Distance Band [mm] 10.0 mm Validation band cw 10000.0, 1.0 10000 Hardware Setup Probe, Calibration Date EUmmWV3 - SN9374_F1-55GHz, 2021-12-21 Medium DAE, Calibration Date mmWave Phantom - 1002 DAE4ip Sn1602, 2021-06-25 Scan Setup Measurement Results 5G Scan 5G Scar Grid Extents [mm] Grid Steps [lambda] Sensor Surface [mm] MAIA 120.0 x 120.0 0.25 x 0.25 2022-01-24, 11:01 Avg. Area (cm²) 4.00 51.5 51.7 51.8 148 0.01 psPDn+ [W/m²] psPDtot+ [W/m²] psPDmod+ [W/m²] 10.0 MAIA not used E_{max} [V/m] Power Drift [dB]



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- End of report -

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