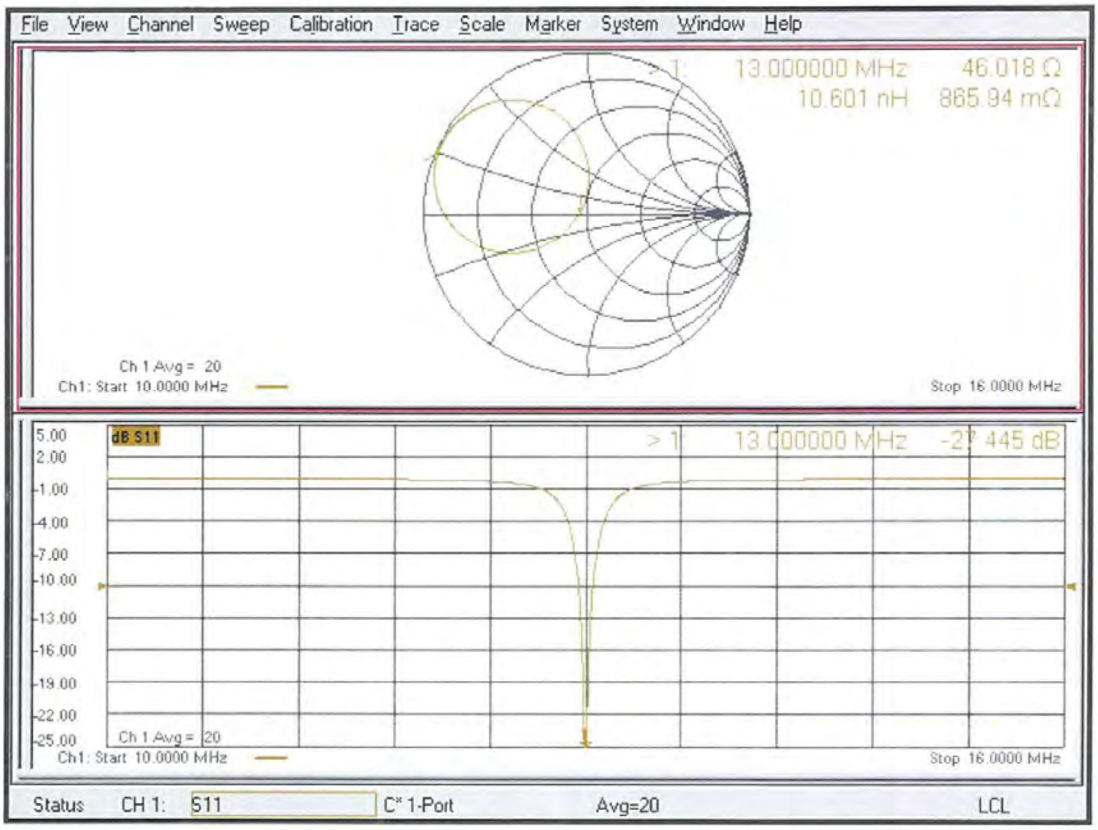
Impedance Measurement Plot for Head TSL



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

S Schweizerischer Kalibrierdienst
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Accreditation No.: SCS 0108

Client **Dt&C**
Gyeonggi-do, Republic of Korea

Certificate No. 5G-Veri10-1026_Jan24

CALIBRATION CERTIFICATE

Object	5G Verification Source 10 GHz - SN: 1026
Calibration procedure(s)	QA CAL-45.v4 Calibration procedure for sources in air above 6 GHz
Calibration date:	January 17, 2024

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
Reference Probe EUmmWV3	SN: 9374	04-Dec-23 (No. EUmm-9374_Dec23)	Dec-24
DAE4	SN: 1215	29-Jun-23 (No. DAE4-1215_Jun23)	Jun-24

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMF100A	SN: 100184	29-Nov-23 (in house check Nov-23)	In house check: Nov-24
Power sensor R&S NRP18S-10	SN: 101258	29-Nov-23 (in house check Nov-23)	In house check: Nov-24
Network Analyzer Keysight E5063A	SN: MY54504221	31-Oct-19 (in house check Oct-22)	In house check: Oct-25

	Name	Function	Signature
Calibrated by:	Joanna Lleshaj	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: January 18, 2024

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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Accreditation No.: **SCS 0108**

Glossary

CW Continuous wave

Calibration is Performed According to the Following Standards

- Internal procedure QA CAL-45, Calibration procedure for sources in air above 6 GHz.
- IEC/IEEE 63195-1, "Assessment of power density of human exposure to radio frequency fields from wireless devices in close proximity to the head and body (frequency range of 6 GHz to 300 GHz)", May 2022

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 horn flange.
- *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 far-field 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 reflections.
- *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 + λ/4) with a vectorial E-field probe. The E-field value stated as calibration value represents the E-field-maxima and the averaged (1cm^2 and 4cm^2) power density values at 10mm in front of the horn.
- *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/m^2) averaged over the surface area of 1 cm^2 and 4cm^2 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%.

Measurement Conditions

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

DASY Version	DASY8 Module mmWave	V3.2
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 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	***Prad***[1] ***(mW)***	**Max E-field (V/m)**	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m²)		Uncertainty (k = 2)
				1 cm²	**4 cm²**	
10 mm	93.3	**152**	1.27 dB	**60.1**	**55.7**	1.28 dB

Distance Horn Aperture to Measured Plane	***Prad***[1] ***(mW)***	**Max E-field (V/m)**	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m²)		Uncertainty (k = 2)
				1 cm²	**4** cm²	
10 mm	93.3	**152**	1.27 dB	**59.9, 60.1, 60.3**	**55.4, 55.7, 56.0**	1.28 dB

Square Averaging

Distance Horn Aperture to Measured Plane	***Prad***[1] ***(mW)***	**Max E-field (V/m)**	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m²)		Uncertainty (k = 2)
				1 cm²	**4** cm²	
10 mm	93.3	**152**	1.27 dB	**60.1**	**55.6**	1.28 dB

Distance Horn Aperture to Measured Plane	***Prad***[1] ***(mW)***	**Max E-field (V/m)**	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m²)		Uncertainty (k = 2)
				1 cm²	**4** cm²	
10 mm	93.3	**152**	1.27 dB	**59.9, 60.1, 60.3**	**55.3, 55.6, 55.9**	1.28 dB

Max Power Density

Distance Horn Aperture to Measured Plane	***Prad***[1] ***(mW)***	**Max E-field (V/m)**	Uncertainty (k = 2)	Max Power Density Sn, Stot, |Stot| (W/m²)	Uncertainty (k = 2)
10 mm	93.3	**152**	1.27 dB	**61.7, 61.8, 61.9**	1.28 dB

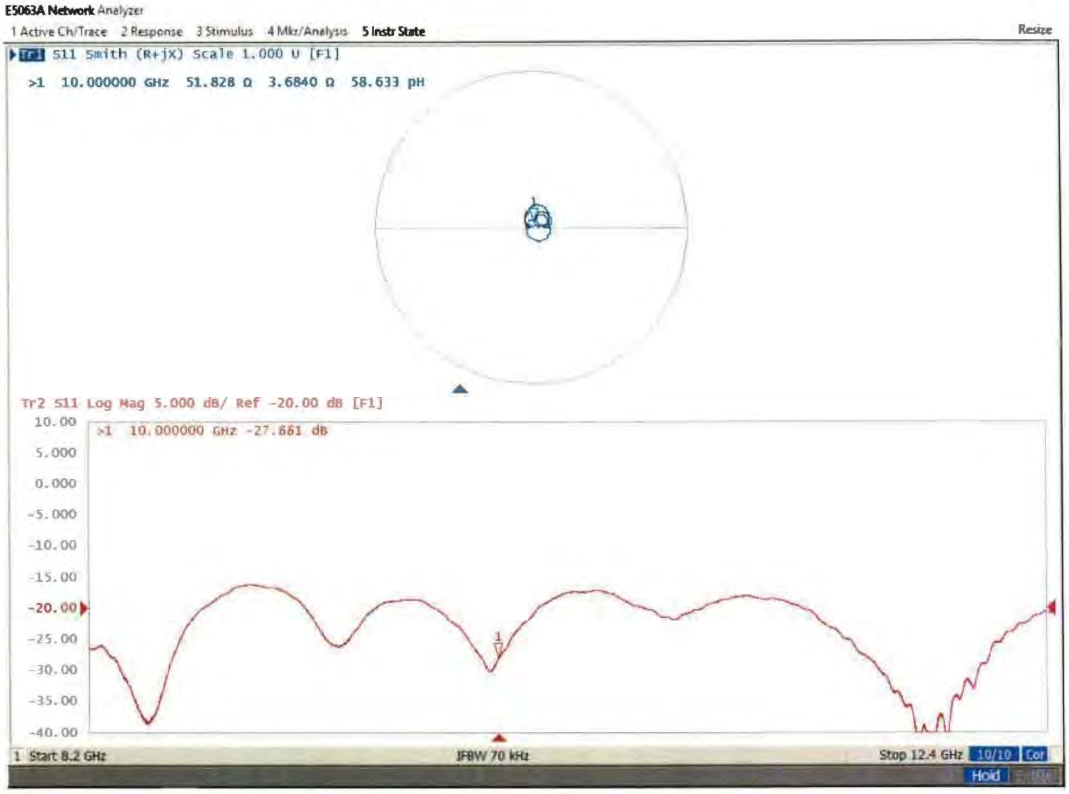
[1] Assessed ohmic and mismatch loss plus numerical offset: 0.30 dB

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Impedance, transformed to feed point	51.8 Ω + 3.7 jΩ
Return Loss	- 27.9 dB

Impedance Measurement Plot



DASY Report

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

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1026	-

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2023-12-04	DAE4 Sn1215, 2023-06-29

Scan Setup

	5G Scan
Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

	5G Scan
Date	2024-01-17, 13:37
Avg. Area [cm²]	1.00
Avg. Type	Circular Averaging
psPDn+ [W/m²]	59.9
psPDtot+ [W/m²]	60.1
psPDmod+ [W/m²]	60.3
Max(Sn) [W/m²]	61.7
Max(Stot) [W/m²]	61.8
Max(|Stot|) [W/m²]	61.9
E_{max} [V/m]	152
Power Drift [dB]	0.01

DASY Report

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

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1026	-

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2023-12-04	DAE4 Sn1215, 2023-06-29

Scan Setup

	5G Scan
Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

	5G Scan
Date	2024-01-17, 13:37
Avg. Area [cm²]	4.00
Avg. Type	Circular Averaging
psPDn+ [W/m²]	55.4
psPDtot+ [W/m²]	55.7
psPDmod+ [W/m²]	56.0
Max(Sn) [W/m²]	61.7
Max(Stot) [W/m²]	61.8
Max(|Stot|) [W/m²]	61.9
E_{max} [V/m]	152
Power Drift [dB]	0.01

DASY Report

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

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1026	-

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2023-12-04	DAE4 Sn1215, 2023-06-29

Scan Setup

	5G Scan
Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

	5G Scan
Date	2024-01-17, 13:37
Avg. Area [cm²]	1.00
Avg. Type	Square Averaging
psPDn+ [W/m²]	59.9
psPDtot+ [W/m²]	60.1
psPDmod+ [W/m²]	60.3
Max(Sn) [W/m²]	61.7
Max(Stot) [W/m²]	61.8
Max(|Stot|) [W/m²]	61.9
E_{max} [V/m]	152
Power Drift [dB]	0.01

DASY Report

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

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN: 1026	-

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2023-12-04	DAE4 Sn1215, 2023-06-29

Scan Setup

	5G Scan
Sensor Surface [mm]	10.0
MAIA	MAIA not used

Measurement Results

	5G Scan
Date	2024-01-17, 13:37
Avg. Area [cm²]	4.00
Avg. Type	Square Averaging
psPDn+ [W/m²]	55.3
psPDtot+ [W/m²]	55.6
psPDmod+ [W/m²]	55.9
Max(Sn) [W/m²]	61.7
Max(Stot) [W/m²]	61.8
Max(|Stot|) [W/m²]	61.9
E_{max} [V/m]	152
Power Drift [dB]	0.01

APPENDIX C. – SAR Tissue Specifications

The brain and muscle mixtures consist of a viscous gel using hydrox-ethylcellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Harts grove.

Figure C.1 Simulated Tissue

Table C.1 Composition of the Tissue Equivalent Matter

Ingredients (% by weight)	Frequency (MHz)							
	835		1 900		2 450		5 200 ~ 5 800	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body
Water	40.19	50.75	55.24	70.23	71.88	73.40	65.52	80.00
Salt (NaCl)	1.480	0.940	0.310	0.290	0.160	0.060	-	-
Sugar	57.90	48.21	-	-	-	-	-	-
HEC	0.250	-	-	-	-	-	-	-
Bactericide	0.180	0.100	-	-	-	-	-	-
Triton X-100	-	-	-	-	19.97	-	17.24	-
DGBE	-	-	44.45	29.48	7.990	26.54	-	-
Diethylene glycol hexyl ether	-	-	-	-	-	-	17.24	-
Polysorbate (Tween) 80	-	-	-	-	-	-		20.00
Target for Dielectric Constant	41.5	55.2	40.0	53.3	39.2	52.7	-	-
Target for Conductivity (S/m)	0.90	0.97	1.40	1.52	1.80	1.95	-	-

Salt:	99 % Pure Sodium Chloride	Sugar:	98 % Pure Sucrose
Water:	De-ionized, 16M resistivity	HEC:	Hydroxyethyl Cellulose
DGBE:	99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]		
Triton X-100(ultra pure):	Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether		

3 Composition / Information on ingredients

3.2 Mixtures
Description: Aqueous solution with surfactants and inhibitors
Declarable, or hazardous components:

CAS: 107-21-1 EINECS: 203-473-3 Reg.nr.: 01-2119456816-28-0000	**Ethanediol** STOT RE 2, H373; Acute Tox. 4, H302	>1.0-4.9%
CAS: 68608-26-4 EINECS: 271-781-5 Reg.nr.: 01-2119527859-22-0000	**Sodium petroleum sulfonate** Eye Irrit. 2, H319	< 2.9%
CAS: 107-41-5 EINECS: 203-489-0 Reg.nr.: 01-2119539582-35-0000	**Hexylene Glycol / 2-Methyl-pentane-2,4-diol** Skin Irrit. 2, H315; Eye Irrit. 2, H319	< 2.9%
CAS: 68920-66-1 NLP: 500-236-9 Reg.nr.: 01-2119489407-26-0000	**Alkoxylated alcohol, > C_{16}** Aquatic Chronic 2, H411; Skin Irrit. 2, H315; Eye Irrit. 2, H319	< 2.0%

Additional information:
For the wording of the listed risk phrases refer to section 16.
Not mentioned CAS-, EINECS- or registration numbers are to be regarded as Proprietary/Confidential.
The specific chemical identity and/or exact percentage concentration of proprietary components is withheld as a trade secret.

Note: Liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Head Tissue Simulating Liquids

Application	Specific absorption rate according to standards (e.g., IEC 62209-x, IEEE 1528)		
Packaging	Plastic container of 10 liters with nozzle		
Life Time	Life time and stability of the liquid depend on usage, storage, and handling of tissue simulating liquid		
Options	Tissue simulating liquids for frequencies outside the below listed ranges are available upon request (please contact info@speag.swiss)		
Head Tissue	Parameters according to IEEE 1528 / IEC 62209-1/ IEC 62209-2 / FCC KDB 865664		
Narrow-Band Solutions (±5% Tolerance)	**Product**	**Test Frequency (MHz)**	**Main Ingredients**
	HSL300V2	300	Water, Sugar
	HSL450V2	450	Water, Sugar
	HSL750V2	750	Water, Sugar
	HSL900V2	835, 900	Water, Sugar
Broad-Band Solutions (±5% Tolerance)	**Product**	**Test Frequency (MHz)**	**Main Ingredients**
	HBBL1350-1850V3	1450 – 1800	Water, Tween
	HBBL1550-1950V3	1750 – 1850	Water, Tween
	HBBL1900-3800V3	1950 – 3000	Water, Tween
	HBBL3500-5800V5	3500 – 5800	Water, Oil
Broad-Band Solutions (±10% Tolerance)	**Product**	**Test Frequency (MHz)**	**Main Ingredients**
	HBBL4-250V3	4 – 250	Water, Tween
	HBBL1350-1850V3	1300 – 1850	Water, Tween
	HBBL1550-1950V3	1550 – 1950	Water, Tween
	HBBL1900-3800V3	1900 – 3800	Water, Tween
	HBBL600-10000V6	600 – 10000	Water, Oil

Head Tissue 4 MHz ~ 250 MHz Simulating Liquids

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Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HBBL4-250V3)**
Product No.	SL AAH 005 AD (Batch: 221018-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

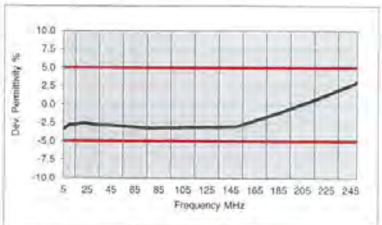
Test Condition

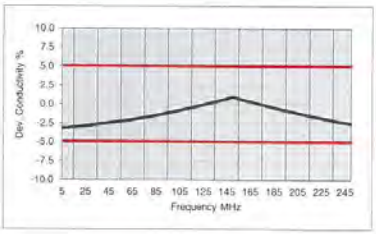
Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	20-Oct-22
Operator	WM

Additional Information

TSL Density	1.042 g/cm3
TSL Heat-capacity	3.574 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	e'	e''	sigma	eps	sigma	Δ-eps	Δ-sigma
5	53.6	2611.49	0.73	55.5	0.75	-3.3	-2.7
10	53.9	1306.12	0.73	55.5	0.75	-2.8	-2.7
15	53.8	871.51	0.73	55.3	0.75	-2.8	-2.7
20	53.7	654.22	0.73	55.1	0.75	-2.6	-2.7
25	53.6	523.68	0.73	55.0	0.75	-2.5	-2.7
30	53.5	437.01	0.73	55.0	0.75	-2.7	-2.7
35	53.4	375.00	0.73	54.9	0.75	-2.7	-2.7
40	53.2	328.52	0.73	54.8	0.75	-2.9	-2.7
45	53.1	292.40	0.73	54.7	0.75	-2.9	-2.7
50	53.0	263.53	0.73	54.6	0.75	-2.8	-2.7
55	52.8	239.94	0.73	54.4	0.75	-3.0	-2.8
60	52.7	220.31	0.74	54.3	0.75	-3.0	-1.5
65	52.5	203.73	0.74	54.2	0.75	-3.2	-1.6
70	52.4	189.53	0.74	54.1	0.75	-3.1	-1.6
75	52.3	177.24	0.74	54.0	0.75	-3.1	-1.7
80	52.2	166.49	0.74	53.9	0.75	-3.1	-1.7
85	52.1	157.02	0.74	53.8	0.75	-3.1	-1.8
90	52.0	148.61	0.74	53.7	0.75	-3.1	-1.9
95	51.9	141.10	0.75	53.5	0.75	-3.1	-0.6
100	51.8	134.35	0.75	53.4	0.75	-3.1	-0.6
105	51.7	128.25	0.75	53.3	0.76	-3.0	-0.7
110	51.6	122.71	0.75	53.2	0.76	-3.0	-0.7
115	51.5	117.65	0.75	53.1	0.76	-3.0	-0.8
120	51.4	113.03	0.75	53.0	0.76	-3.0	-0.9
125	51.2	108.77	0.76	52.9	0.76	-3.1	0.4
130	51.1	104.85	0.76	52.8	0.76	-3.1	0.4
135	51.0	101.22	0.76	52.6	0.76	-3.1	0.3
140	50.9	97.86	0.76	52.5	0.76	-3.1	0.2
145	50.8	94.73	0.76	52.4	0.76	-3.1	0.2
150	50.8	91.82	0.77	52.3	0.76	-2.9	1.5
155	50.7	89.09	0.77	52.1	0.76	-2.6	1.0
160	50.6	86.54	0.77	51.8	0.77	-2.4	0.5
165	50.5	84.15	0.77	51.6	0.77	-2.1	0.0
170	50.4	81.90	0.77	51.4	0.77	-1.9	-0.5
175	50.3	79.76	0.78	51.1	0.78	-1.6	0.4
180	50.2	77.78	0.78	50.9	0.78	-1.4	-0.1
185	50.1	75.88	0.78	50.7	0.78	-1.1	-0.6
190	50.0	74.10	0.78	50.4	0.79	-0.9	-1.0
195	49.9	72.41	0.79	50.2	0.79	-0.6	-0.2
200	49.8	70.80	0.79	50.0	0.80	-0.3	-0.7
205	49.8	69.27	0.79	49.7	0.80	0.1	-1.2
210	49.7	67.82	0.79	49.5	0.80	0.4	-1.6
215	49.6	66.43	0.79	49.3	0.81	0.7	-2.1
220	49.5	65.11	0.80	49.0	0.81	1.0	-1.3
225	49.4	63.85	0.80	48.8	0.81	1.2	-1.7
230	49.4	62.64	0.80	48.6	0.82	1.7	-2.1
235	49.3	61.49	0.80	48.3	0.82	2.0	-2.6
240	49.2	60.38	0.81	48.1	0.82	2.3	-1.8
245	49.1	59.32	0.81	47.9	0.83	2.6	-2.2
250	49.0	58.31	0.81	47.6	0.83	2.9	-2.7





Head Tissue 600 MHz ~ 10000 MHz Simulating Liquids

Schmid & Partner Engineering AG

s p e a g

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Phone +41 44 245 9700, Fax +41 44 245 9779
www.speag.swiss, info@speag.swiss

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HBBL600-10000V6)**
Product No.	SL AAH U16 BC (Batch: 230313-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

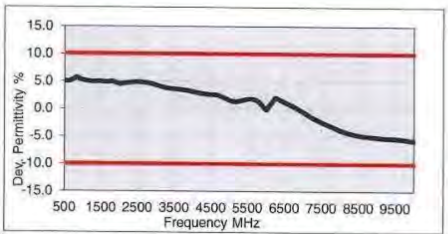
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	17-Mar-23
Operator	WM

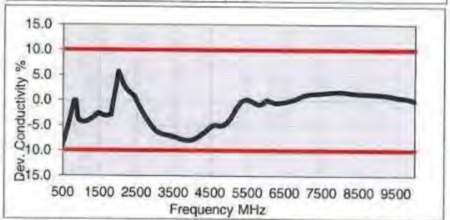
Additional Information

TSL Density	
TSL Heat-capacity	

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	e'	e"	sigma	eps	sigma	Δ-eps	Δ-sigma
600	44.9	24.8	0.83	42.7	0.88	5.1	-5.9
750	44.2	21.0	0.88	41.9	0.89	5.4	-1.5
800	44.0	20.1	0.90	41.7	0.90	5.6	0.3
825	44.0	19.8	0.91	41.6	0.91	5.8	0.4
835	44.0	19.6	0.92	41.5	0.91	5.9	0.9
850	43.9	19.4	0.92	41.5	0.92	5.8	0.4
900	43.7	18.7	0.94	41.5	0.97	5.3	-3.1
1400	42.6	14.7	1.15	40.6	1.18	4.9	-2.5
1450	42.5	14.5	1.17	40.5	1.20	4.9	-2.5
1600	42.3	14.0	1.25	40.3	1.28	4.9	-2.7
1625	42.3	13.9	1.26	40.3	1.30	5.0	-3.0
1640	42.3	13.9	1.27	40.3	1.31	5.1	-2.8
1650	42.2	13.9	1.27	40.2	1.31	4.9	-3.3
1700	42.1	13.8	1.30	40.2	1.34	4.8	-3.1
1750	42.1	13.7	1.33	40.1	1.37	5.0	-3.0
1800	42.0	13.6	1.36	40.0	1.40	5.0	-2.9
1810	42.0	13.6	1.37	40.0	1.40	5.0	-2.1
1825	42.0	13.5	1.38	40.0	1.40	5.0	-1.4
1850	42.0	13.5	1.39	40.0	1.40	5.0	-0.7
1900	41.9	13.4	1.42	40.0	1.40	4.7	1.4
1950	41.8	13.4	1.45	40.0	1.40	4.5	3.6
2000	41.8	13.3	1.48	40.0	1.40	4.5	5.7
2050	41.7	13.3	1.51	39.9	1.44	4.5	4.5
2100	41.7	13.2	1.55	39.8	1.49	4.7	4.1
2150	41.6	13.2	1.58	39.7	1.53	4.7	3.0
2200	41.5	13.2	1.62	39.6	1.58	4.7	2.7
2250	41.4	13.2	1.65	39.6	1.62	4.7	1.7
2300	41.3	13.2	1.69	39.5	1.67	4.6	1.4
2350	41.3	13.3	1.73	39.4	1.71	4.9	1.1
2400	41.2	13.3	1.77	39.3	1.76	4.9	0.8
2450	41.1	13.3	1.81	39.2	1.80	4.8	0.6
2500	41.1	13.3	1.85	39.1	1.85	5.0	-0.2
2550	41.0	13.3	1.89	39.1	1.91	4.9	-1.0
2600	40.9	13.4	1.93	39.0	1.96	4.8	-1.7
3500	39.3	13.9	2.70	37.9	2.91	3.6	-7.2
3700	39.0	14.0	2.88	37.7	3.12	3.4	-7.7
5200	36.5	15.8	4.58	36.0	4.66	1.3	-1.5
5250	36.4	16.0	4.66	35.9	4.71	1.4	-1.0
5300	36.4	16.1	4.73	35.9	4.76	1.5	-0.5
5500	36.3	16.2	4.97	35.6	4.96	1.8	0.1
5600	36.2	16.2	5.06	35.5	5.07	1.8	-0.2
5700	36.0	16.2	5.14	35.4	5.17	1.6	-0.6
5800	35.7	16.2	5.22	35.3	5.27	1.2	-0.9
6000	35.0	16.4	5.48	35.1	5.48	-0.2	0.1
6500	34.9	16.7	6.05	34.5	6.07	1.2	-0.4
7000	33.7	17.2	6.72	33.9	6.65	-0.6	1.0
7500	32.5	17.6	7.34	33.3	7.24	-2.5	1.4
8000	31.4	17.9	7.97	32.7	7.84	-3.9	1.7
8500	30.6	18.1	8.57	32.1	8.45	-4.8	1.3
9000	29.9	18.3	9.18	31.5	9.08	-5.2	1.2
9500	29.3	18.5	9.77	31.0	9.71	-5.4	0.6
10000	28.6	18.6	10.35	30.4	10.36	-5.9	-0.1





APPENDIX D. – SAR SYSTEM VALIDATION

SAR System Validation

Per FCC KDB 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01v01r04 and IEEE 1528-2013.Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table D.1 SAR System Validation Summary

SAR System	Freq. [MHz]	Date	Probe SN	Probe Type	Probe CAL. Point		PERM.	COND.	CW Validation			MOD. Validation		
							(εr)	(σ)	Sensi-tivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
D	13	2023.11.07	3933	EX3DV4	13	Head	55.487	0.778	PASS	PASS	PASS	ASK	N/A	PASS
A	2 450	2024.02.16	3327	ES3DV3	2 450	Head	39.788	1.824	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
A	2 450	2023.08.01	3930	EX3DV4	2 450	Head	39.089	1.810	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
A	2 450	2023.12.19	7368	EX3DV4	2 450	Head	38.588	1.775	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
D	5 200	2023.11.14	3933	EX3DV4	5 200	Head	36.356	4.779	PASS	PASS	PASS	OFDM	N/A	PASS
D	5 300	2023.11.14	3933	EX3DV4	5 300	Head	35.845	4.935	PASS	PASS	PASS	OFDM	N/A	PASS
D	5 500	2023.11.15	3933	EX3DV4	5 500	Head	35.437	5.127	PASS	PASS	PASS	OFDM	N/A	PASS
D	5 600	2023.11.15	3933	EX3DV4	5 600	Head	35.266	5.240	PASS	PASS	PASS	OFDM	N/A	PASS
D	5 800	2023.11.15	3933	EX3DV4	5 800	Head	35.169	5.444	PASS	PASS	PASS	OFDM	N/A	PASS
A	6 500	2023.12.27	7368	EX3DV4	6 500	Head	34.577	6.092	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: The probes have been calibrated for both a CW and modulated signals. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

APPENDIX E. – Description of Test Equipment

E.1 SAR and Power Density Measurement Setup

Measurements are performed using the DASY5 automated dosimetric assessment system. The DASY5 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. E.1.1).

A cell controller system contains the power supply, robot controller each pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Intel Core i7-3 770 3.40 GHz desktop computer with Windows 7 system and SAR Measurement Software DASY5, A/D interface card, monitor, mouse, and keyboard. The Staubli Robotis connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

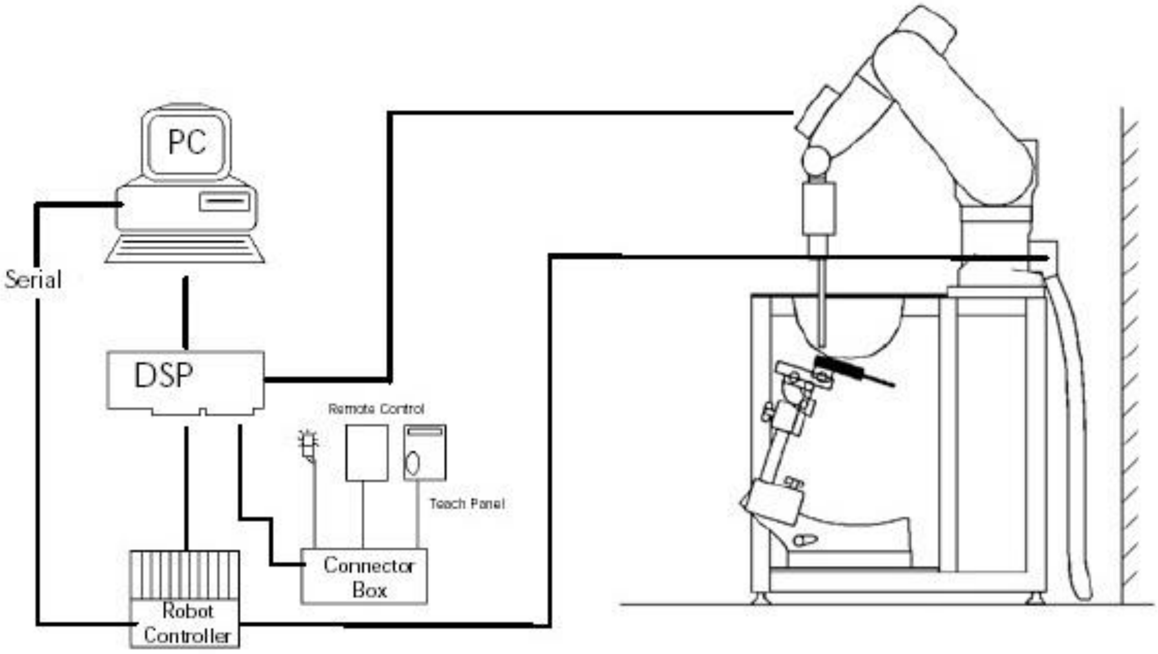
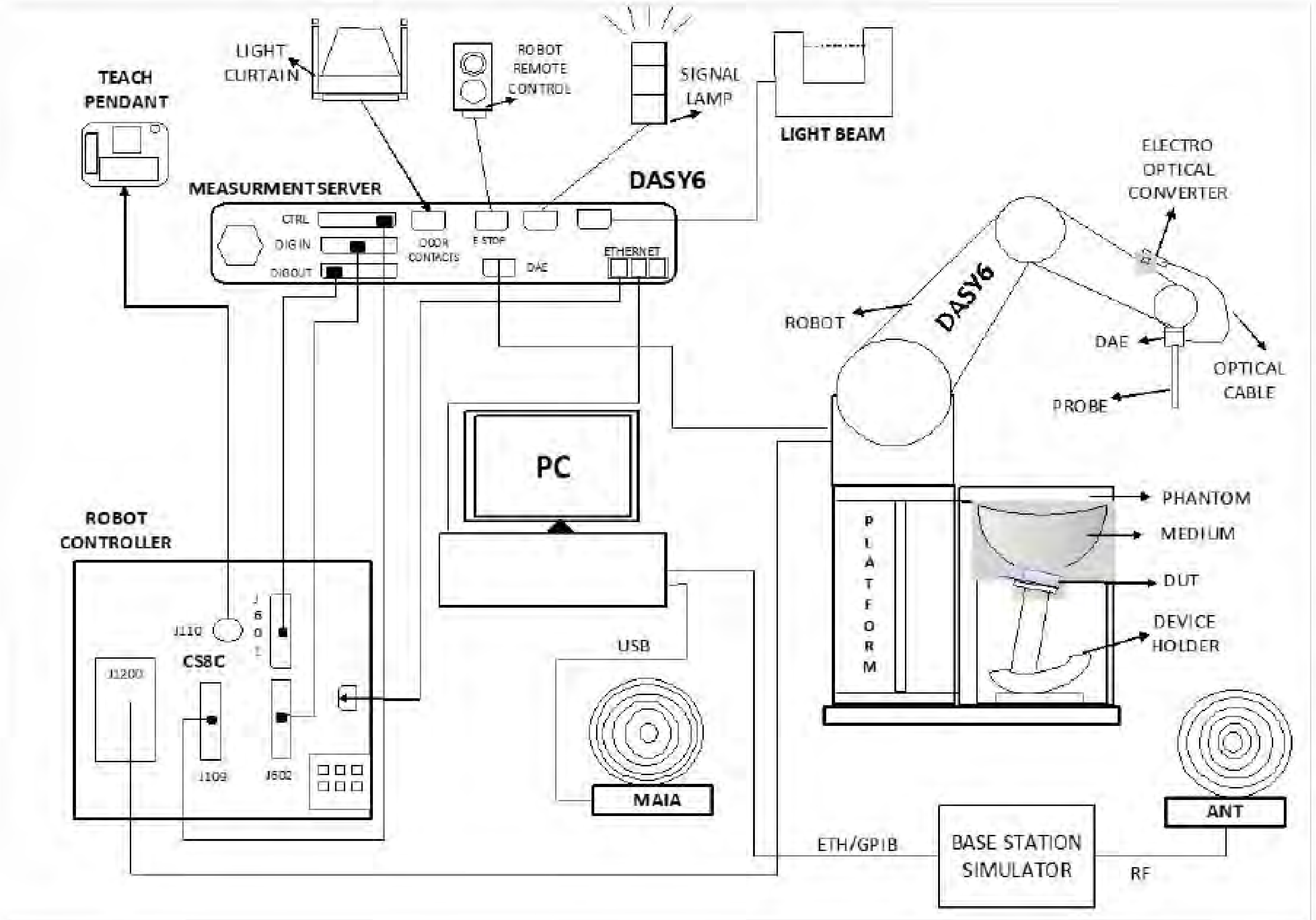


Figure E.1.1 SAR Measurement System Setup

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail.

The DASY6 system used for performing compliance tests consists of the following items



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A compute running Win10 and the DASY6 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

SAR Scan Procedures

Step 1: Power Reference Measurement
The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hotspot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEC/IEEE Standard 62209-1528, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from IEC/IEEE Standard 62209-1528:2020.

Parameter	**DUT transmit frequency being tested**	
	$f \leq 3$ GHz	**3 GHz $< f \leq 10$ GHz**
Maximum distance between the measured points (geometric centre of the sensors) and the inner phantom surface (z_{M1} in Figure 20 in mm)	5 ± 1	δ ln(2)/2 ± 0,5 [a]
Maximum spacing between adjacent measured points in mm (see O.8.3.1)[b]	20, or half of the corresponding zoom scan length, whichever is smaller	60 / f, or half of the corresponding zoom scan length, whichever is smaller
Maximum angle between the probe axis and the phantom surface normal (α in Figure 20)[c]	5° (flat phantom only) 30° (other phantoms)	5° (flat phantom only) 20° (other phantoms)
Tolerance in the probe angle	1°	1°

[a] δ is the penetration depth for a plane-wave incident normally on a planar half-space.

[b] See Clause O.8 on how Δx and Δy may be selected for individual area scan requirements.

[c] The probe angle relative to the phantom surface normal is restricted due to the degradation in the measurement accuracy in fields with steep spatial gradients. The measurement accuracy decreases with increasing probe angle and increasing frequency. This is the reason for the tighter probe angle restriction at frequencies above 3 GHz.

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1g and 10g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1g and 10g and displays these values next to the job's label

Zoom Scan Parameters extracted from IEC/IEEE Standard 62209-1528:2020.

Parameter	DUT transmit frequency being tested	
	$f \leq 3$ GHz	3 GHz < $f \leq 10$ GHz
Maximum distance between the closest measured points and the phantom surface (z_{M1} in Figure 20 and Table 3, in mm)	5	$\delta \ln(2)/2$ [a]
Maximum angle between the probe axis and the phantom surface normal (α in Figure 20)	5° (flat phantom only) 30° (other phantoms)	5° (flat phantom only) 20° (other phantoms)
Maximum spacing between measured points in the x- and y-directions (Δx and Δy, in mm)	8	$24/f$ [b]
For uniform grids: Maximum spacing between measured points in the direction normal to the phantom shell (Δz_1 in Figure 20, in mm)	5	$10/(f-1)$
For graded grids: Maximum spacing between the two closest measured points in the direction normal to the phantom shell (Δz_1 in Figure 20, in mm)	4	$12/f$
For graded grids: Maximum incremental increase in the spacing between measured points in the direction normal to the phantom shell ($R_z = \Delta z_2/\Delta z_1$ in Figure 20)	1,5	1,5
Minimum edge length of the zoom scan volume in the x- and y-directions (L_z in O.8.3.2, in mm)	30	22
Minimum edge length of the zoom scan volume in the direction normal to the phantom shell (L_h in O.8.3.2 in mm)	30	22
Tolerance in the probe angle	1°	1°

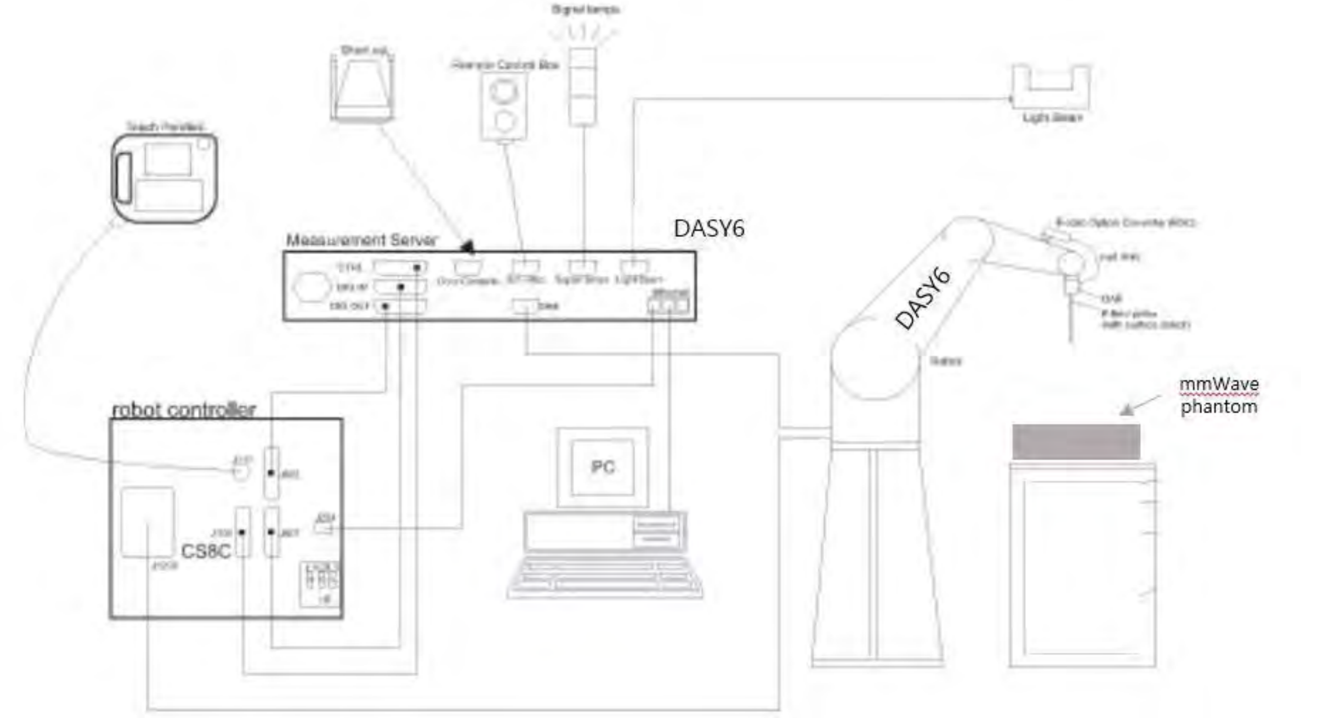
[a] δ is the penetration depth for a plane-wave incident normally on a planar half-space.

[b] This is the maximum spacing allowed, which might not work for all circumstances.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at The same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch proces. The measurement procedure is the same as Step 1.

The DASY6 system used for performing compliance tests consists of the following items



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- The EUmmWVx probe is based on the pseudo-vector probe design, which not only measures the field magnitude but also derives its polarization ellipse.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win10 and the DASY6 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom which is specialized for 5G other accessories according to the targeted measurement.

Power Density Scan Procedures

Step 1: Power Reference Measurement
The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to devise under test.

Step 2: 5G Scan
The steps in the X, Y, and Z directions are specified in terms of fractions of the signal wavelength, lambda.
Area Scan Parameters extracted from DASY6 Module mmWave Manual

Recommended settings for measurement of verification sources

Frequency [GHz]	Grid step	Grid extent X/Y [mm]	Measurement points
10	0.125 ($\frac{\lambda}{8}$)	60/60	18 × 18
30	0.25 ($\frac{\lambda}{4}$)	60/60	26 × 26
45	0.25 ($\frac{\lambda}{4}$)	42/42	28 × 28
60	0.25 ($\frac{\lambda}{4}$)	32.5/32.5	28 × 28
90	0.25 ($\frac{\lambda}{4}$)	30/30	38 × 38

The minimum distance of probe sensors to verification source surface, horn antenna, is 10mm.

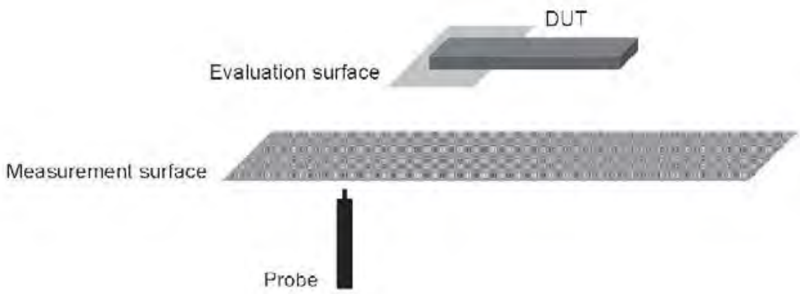
Per equipment manufacturer guidance for 6-10GHz, Power density was measured at d=2mm.

Step 3: Power drift measurement
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1. When the drift is larger than ± 5%, test is repeated from step 1.

Total Field and Power Flux Density Reconstruction (measurement distance)

Reconstruction algorithms are used to project or transform the measured fields from the measurement surface to the evaluation surface (below fig) in order to determine power density or to compute spatial-average and/or local power density with known uncertainty.

Manufacture has developed a reconstruction approach based on the Gerchberg-saxton algorithm, which benef ts from the availability of the E-field polarization ellipse information obtained with the EUmmWVx probe. Thi s reconstruction algorithm, together with the ability of the probe to measure extremely close to the source without perturbing the field, permits reconstruction of the E- and H-fields, as well as of the power density, on measurement planes.



E.2 Probe Specification

Frequency	4 MHz to 4 GHz/4 MHz to 10 GHz
Linearity	±0.2 dB(30 MHz to 4 GHz/30 MHz to 10 GHz)
Dynamic	10 μW/g to > 100 mW/g
Range	Linearity : ±0.2 dB
Dimensions	Overall length : 337 mm
Tip length	20 mm
Body diameter	12 mm
Tip diameter	3.9 mm/2.5 mm
Distance from probe tip to sensor center	3.9 mm/2.5 mm
Application	SAR Dosimetry Testing Compliance tests of mobile phones

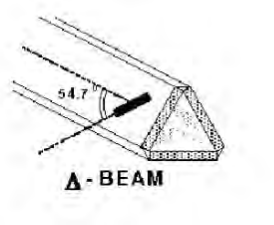


Figure E.2.1 Triangular Probe Configurations

Figure E.2.2 Probe Thick-Film Technique

DAE System

The SAR measurements were conducted with the dosimetric probe ES3DV3 and EX3DV4 designed in the classical triangular configuration(see E.2.1) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multitier line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY5 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

E.3 E-Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than ±10%. The spherical isotropy was evaluated with the procedure and found to be better than ±0.25 dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent the remits or based temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

$$\text{SAR} = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to ΔT / Δt , the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

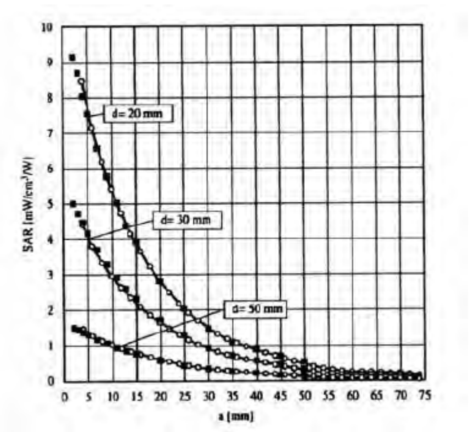


Figure E.3.1 E-Field and Temperature Measurements at 900MHz

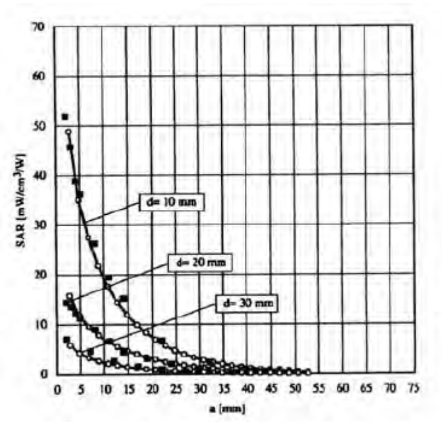


Figure E.3.2 E-Field and Temperature Measurements at 1 800MHz

E.4 Data Extrapolation

The DASY5 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

E.5 SAM Twin Phantom

The SAM Twin Phantom V5.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90 % of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid.

Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. E.5.1)

Figure E.5.1 SAM Twin Phantom

SAM Twin Phantom Specification:

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.
Shell Thickness	(2 ± 0.2) mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet

Specific Anthropomorphic Mannequin (SAM) Specifications:

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. E.5.2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

Figure E.5.2 Sam Twin Phantom shell

E.6 ELI PHANTOM

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid.

Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles. ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4, but has reinforced top structure. (see Fig. F.5.1)

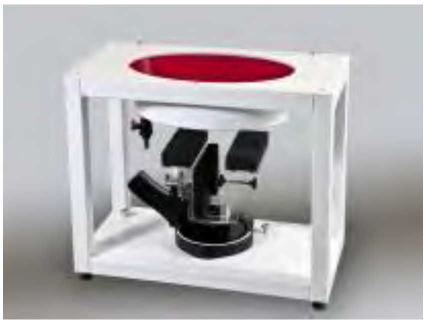


Figure E.6.1 ELI Phantom

<u>ELI Phantom Specification</u>

Shell Thickness	(2.0 ± 0.2) mm (bottom plate)
Dimensions	Major axis: 600 mm, Minor: 400 mm
Filling Volume	Approx. 30 liters

E.7 Device Holder for Transmitters

In combination with the Twin SAM Phantom V4.0/V4.0c, V5.0 or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).
Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Figure E.7.1 Mounting Device

E.8 Automated Test System Specifications

Positioner

Robot	Stäubli Unimation Corp. Robot Model: TX60L/TX90XL
Repeatability	0.02 mm
No. of axis	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i7-3 770/ i7-8 700K, Intel Xeon W-2 255
Clock Speed	3.40 GHz/3.70 GHz
Operating System	Windows 7 Professional/Windows 10 Pro
Data Card	DASY5/6 PC-Board

Data Converter

Features	Signal, multiplexer, A/D converter. & control logic
Software	DASY5/6
Connecting Lines	Optical downlink for data and status info Optical uplink for commands and clock

PC Interface Card

Function	24 bit (64 MHz) DSP for real time processing Link to DAE 4 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probes

Model	ES3DV3 S/N: 3327, EX3DV4 S/N: 3930/3916/3933/7368, EUmmWV3 S/N: 9400
Construction	Triangular core fiber optic detection system
Frequency	4 MHz to 4 GHz/4 MHz to 10 GHz/750 MHz to 110 GHz
Linearity	±0.2 dB (30 MHz to 4 GHz/30 MHz to 10 GHz)

Phantom

Phantom	SAM Twin Phantom (V5.0) / ELI Phantom (V6.0)
Shell Material	Composite
Thickness	(2.0 ± 0.2) mm

Figure E.8.1 DASY5 Test System