CALIBRATION DATA PROBE CALIBRATION DATA

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





S Schweizerischer Kalibrierdienst
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Swiss Calibration Service

Accreditation No.: SCS 0108

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Multilateral Agreement for the recognition of calibration certificates

Client

AGC-CERT (Auden)

Certificate No: ES3-3337_Sep20

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3337

Calibration procedure(s) QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v7

Calibration procedure for dosimetric E-field probes

Calibration date: September 8, 2020

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
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: CC2552 (20x)	31-Mar-20 (No. 217-03106)	Apr-21
DAE4	SN: 660	27-Dec-19 (No. DAE4-660_Dec19)	Dec-20
Reference Probe ES3DV2	SN: 3013	31-Dec-19 (No. ES3-3013_Dec19)	Dec-20
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

Calibrated by:

Name
Function
Signature

Laboratory Technician

Approved by:

Katja Pokovic
Technical Manager

Issued: September 8, 2020

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

Certificate No: ES3-3337_Sep20 Page 1 of 9

Calibration Laboratory of Schmid & Partner Engineering AG





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Glossary:

NORMx,y,z ConvF

tissue simulating liquid sensitivity in free space sensitivity in TSL / NORMx,y,z diode compression point

DCP CF A, B, C, D

crest factor (1/duty_cycle) of the RF signal modulation dependent linearization parameters

φ rotation around probe axis

Polarization o Polarization 9

9 rotation around an axis that is in the plane normal to probe axis (at measurement center),

i.e., $\vartheta = 0$ is normal to probe axis

information used in DASY system to align probe sensor X to the robot coordinate system Connector Angle

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 IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from handheld and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016 IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices
- used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010 KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D are numerical linearization parameters assessed based on
- Ax,y,z; bx,y,z; bx,y,z; bx,y,z; bx,y,z; bx,y,z; bx,y,z; Ax, b, c, b are numerical interioral metalization parameters assessed observed the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.

 ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom
- exposed by a patch antenna.

 Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx (no uncertainty required).

ES3DV3 - SN:3337

September 8, 2020

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3337

Basic Calibration Parameters

Dasic Campianon i arai	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) ²) ^A	1.27	1.31	1.39	± 10.1 %
DCP (mV) ⁶	107.4	106.7	108.6	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	С	D dB	VR mV	Max dev.	Unc ^e (k=2)
0	CW	X	0.0	0.0	1.0	0.00	190.6	± 3.5 %	± 4.7 %
		Υ	0.0	0.0	1.0	Ī	173.5		
		Z	0.0	0.0	1.0		172.5		

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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A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 5).

B Numerical linearization parameter: uncertainty not required.

Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

ES3DV3-- SN:3337 September 8, 2020

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3337

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-81.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an Area Scan job.

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ES3DV3-SN:3337 September 8, 2020

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3337

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
150	52.3	0.76	7.80	7.80	7.80	0.10	1.20	± 13.3 %
450	43.5	0.87	6.93	6.93	6.93	0.20	1.50	± 13.3 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), clso it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

**At frequencies below 3 GHz, the validity of tissue parameters (a and σ) can be releaxed to ± 10% if liquid componsation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (c and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

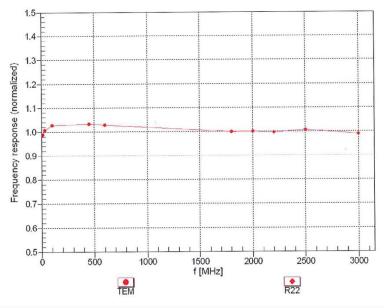
**Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-8 GHz at any distance larger than half the probe tip diameter from the boundary.

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ES3DV3-SN:3337

September 8, 2020

Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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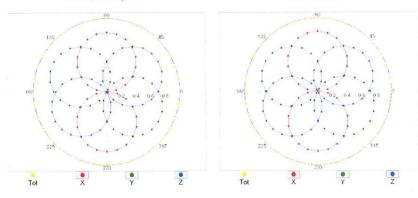
ES3DV3-SN:3337

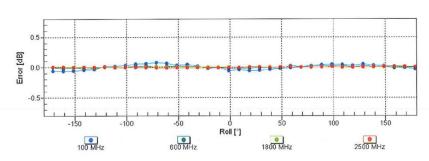
September 8, 2020

Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$



f=1800 MHz,R22

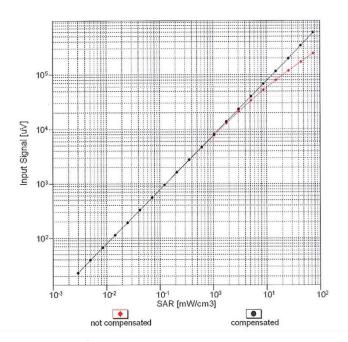


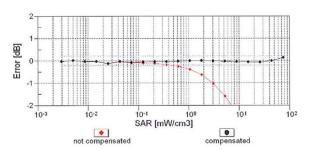


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ES3DV3- SN:3337 September 8, 2020

Dynamic Range f(SAR_{head}) (TEM cell , f_{eval}= 1900 MHz)





Uncertainty of Linearity Assessment: ± 0.6% (k=2)

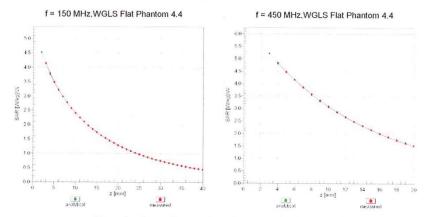
Certificate No: ES3-3337_Sep20

Page 8 of 9

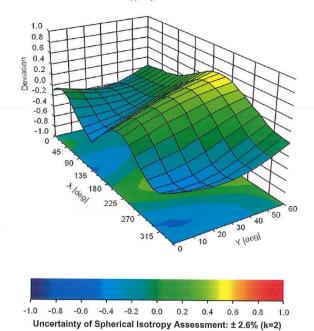
ES3DV3-SN:3337

September 8, 2020

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, ϑ) , f = 900 MHz



Certificate No: ES3-3337_Sep20

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DAE CALIBRATION DATA

Http://www.chinattl.cn



E-mail: cttl@chinattl.com Client:

agc-cert

Certificate No: Z21-60193

CALIBRATION CERTIFICATE Object DAE4 - SN: 1398 Calibration Procedure(s) FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx) Calibration date: May 17, 2021 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(Calibrated by, Certificate No.) Scheduled Calibration Process Calibrator 753 1971018 16-Jun-20 (CTTL, No.J20X04342) Jun-21 Function Name Calibrated by: Yu Zongying SAR Test Engineer

Issued: May 19, 2021

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

Lin Hao

Qi Dianyuan

Reviewed by:

Approved by:

SAR Test Engineer

SAR Project Leader



 Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China

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 F-mail: cttl@chinattl.com
 flttp://www.chinattl.cn

Glossary:

DAE data acquisition electronics

Connector angle information used in DASY system to align probe sensor X

to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: ~86-10-62304633-2512 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com Http://www.chinattl.cn

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	х	Υ	Z .
High Range	404.197 ± 0.15% (k=2)	404.183 ± 0.15% (k=2)	403.640 ± 0.15% (k=2)
Low Range	3.97363 ± 0.7% (k=2)	3.99187 ± 0.7% (k=2)	3.96954 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	47.5° ± 1 °
·	

Certificate No: Z21-60193

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DIPOLE CALIBRATION DATA

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Client

AGC-CERT (Auden)

Certificate No: D450V3-1113 Feb21

Object	D450V3 - SN:11	13	
Calibration procedure(s)	QA CAL-15.v9		
sanoration procedure(s)		edure for SAR Validation Sources	s below 700 MHz
			2 2010 11 7 00 11 11 12
Calibration date:	February 05, 202	21	
		ional standards, which realize the physical ur	
he measurements and the uncer	tainties with confidence p	probability are given on the following pages ar	nd are part of the certificate.
All calibrations have been conduct	ed in the closed laborate	ry facility: environment temperature (22 \pm 3)°	C and humidity 700
an editoriations have been conduct	od in the closed laborato	ry facility. environment temperature (22 ± 3)	G and numidity < 70%.
Calibration Equipment used (M&T	E critical for calibration)		
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
	SN: CC2552 (20x)	31-Mar-20 (No. 217-03106)	Apr-21
Reference 20 dB Attenuator		31-Mar-20 (No. 217-03104)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mai-20 (NO. 217-03104)	Apr-21
Type-N mismatch combination Reference Probe EX3DV4	SN: 310982 / 06327 SN: 3877	30-Dec-20 (No. EX3-3877_Dec20)	Dec-21
Type-N mismatch combination Reference Probe EX3DV4			
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 3877	30-Dec-20 (No. EX3-3877_Dec20)	Dec-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 3877 SN: 654 ID # SN: GB41293874	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20)	Dec-21 Jun-21 Scheduled Check
Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor E4412A	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-22
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor E4412A	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-22 In house check: Jun-22
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor E4412A RF generator HP 8648C	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210 SN: US3642U01700	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 04-Aug-99 (in house check Jun-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-22 In house check: Jun-22 In house check: Jun-22
Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor E4412A RF generator HP 8648C	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-22 In house check: Jun-22 In house check: Jun-22
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor E4412A Power sensor E4412A RF generator HP 8648C Network Analyzer Agilent E8358A	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210 SN: US3642U01700	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 04-Aug-99 (in house check Jun-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-22 In house check: Jun-22 In house check: Jun-22
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor E4412A Power sensor E4412A RF generator HP 8648C Retwork Analyzer Agilent E8358A	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210 SN: US41080477	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 04-Aug-99 (in house check Jun-20) 31-Mar-14 (in house check Oct-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-22 In house check: Jun-22 In house check: Jun-22 In house check: Jun-22 In house check: Oct-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor E4412A Power sensor E4412A RF generator HP 8648C	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210 SN: US3642U01700 SN: US41080477	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 04-Aug-99 (in house check Jun-20) 31-Mar-14 (in house check Oct-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-22 In house check: Jun-22 In house check: Jun-22 In house check: Jun-22 In house check: Oct-21
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor E4412A Power sensor E4412A RF generator HP 8648C Network Analyzer Agilent E8358A	SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210 SN: US3642U01700 SN: US41080477	30-Dec-20 (No. EX3-3877_Dec20) 26-Jun-20 (No. DAE4-654_Jun20) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 04-Aug-99 (in house check Jun-20) 31-Mar-14 (in house check Oct-20)	Dec-21 Jun-21 Scheduled Check In house check: Jun-2: In house check: Jun-2: In house check: Jun-2: In house check: Jun-2: In house check: Oct-2:

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





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Glossary:

TSL ConvF tissue simulating liquid

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 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
- 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%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy , $dz = 5 mm$	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	44.0 ± 6 %	0.87 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	1.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.61 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.770 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.09 W/kg ± 17.6 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.7 Ω - 5.3)Ω
Return Loss	- 22.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1 240 ==
= 15 tirida Belay (ello dilaction)	1.349 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

DASY5 Validation Report for Head TSL

Date: 05.02.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1113

Communication System: UID 0 - CW; Frequency: 450 MHz

Medium parameters used: f = 450 MHz; $\sigma = 0.87$ S/m; $\varepsilon_r = 44.0$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64, 10.64) @ 450 MHz; Calibrated: 30.12.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn654; Calibrated: 26.06.2020

Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003

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

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 39.04 V/m; Power Drift = -0.01 dB

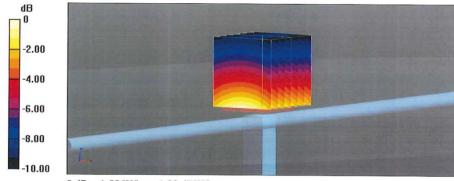
Peak SAR (extrapolated) = 1.78 W/kg

SAR(1 g) = 1.15 W/kg; SAR(10 g) = 0.770 W/kg

Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 30mm)

Ratio of SAR at M2 to SAR at M1 = 64.6%

Maximum value of SAR (measured) = 1.55 W/kg



0 dB = 1.55 W/kg = 1.90 dBW/kg

Impedance Measurement Plot for Head TSL

