SAR Compliance Test Report

Date of Report	29/12/2023	**Client's Contact person:**	Christian Gerber
Number of pages:	28		
		Responsible Test engineer:	Jesper Varis
Testing laboratory:	**Verkotan Oy** Elektroniikkatie 17 90590 Oulu Finland	**Client:**	**Kistler Instrumente AG** Eulachstrasse 22 8408 Winterthur Switzerland
Tested device	Handheld measurement device 5811A00		
Related reports:	-		
Testing has been carried out in accordance with:	**47CFR §2.1093** Radiofrequency Radiation Exposure Evaluation: Portable Devices **FCC published RF exposure KDB procedures** **IEC/IEEE 62209-1528, 2020** Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices **RSS-102, Issue 5, 2015** Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)		
Documentation:	The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory		
Test Results:	**The EUT complies with the requirements in respect of all parameters subject to the test.** The test results relate only to devices specified in this document		
Date and signatures:	29.12.2023 *Miia Nurkkala* **Laboratory Manager**		

TABLE OF CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (DUT):

Variant #1:

PMN:	Handheld Charge
FVIN:	1.0
HVIN:	5811A00
Hardware Version:	A

Variant #2:

PMN:	Handheld I/O-Link
FVIN:	1.0
HVIN:	5811A01
Hardware Version:	A

Manufacturer:	Kistler
FCC ID Number:	2AWIT-5811A
ISED ID Number:	28487-5811A
DUT Number:	21383 (radiated sample), 21384 (conducted sample)
Battery Type used in testing:	Li-Ion Battery
Serial Number of the tested DUT:	0
State of the Sample:	Production sample

Testing information:

Testing performed:	15.02.2023 – 21.02.2023
Notes:	-
Document history:	This report replaces test report FCC_ISED SAR report_Handheld Messgerät_ID6014_29112023.docx Equipment list updated. Variant information added to pages 3 and 5.
Document ID:	FCC_ISED SAR report_Handheld Messgerät_ID6014_29122023.docx
Temperature °C	22±2 / Controlled
Humidity RH%	30±20 / Controlled
Measurement performed by:	Jesper Varis
FCC Test Firm Designation Number:	FI0005
ISED Company Number:	22218

1.2 Maximum Results

The maximum reported* SAR values for Body-worn and Extremity-configuration for transmitting systems are shown in a table below. The device conforms to the requirements of the standards when the maximum reported SAR value is less than or equal to the limit. The SAR limit specified in FCC 47 CFR part 2 (2.1093) and Health Canada's RF exposure guideline, Safety Code 6 for Body SAR_{1g} is 1.6 W/kg and for Extremity SAR_{10g} is 4.0 W/kg.

1.2.1 Standalone SAR

System	Highest Reported* SAR_{1g}(W/kg) in Body-Worn Exposure Condition, 0mm separation distance	Highest Reported* SAR_{10g}(W/kg) in Extremity Exposure Condition, 0mm separation	Result
2.4 GHz WLAN	1.08	0.49	PASS
Bluetooth BR	0.12	0.06	PASS

* Reported SAR Values are scaled to upper limit of power tuning tolerance.

1.2.2 Simultaneous Transmission SAR

Highest Simultaneous Transmission SAR	SAR_{1g}(W/kg) in Body-Worn Exposure Condition	SAR_{10g}(W/kg) in Extremity Exposure Condition	Result
WLAN 2.4 GHz + Bluetooth BR	1.20	0.55	PASS

1.2.3 Maximum Drift

Maximum Drift During Measurements	0.88dB*

*Larger than 5% drifts included to scaling factors

1.2.4 Measurement Uncertainty

SAR 1g: 0.3 – 3 GHz:

Expanded Uncertainty (k=2) 95 %	±22.1 %

SAR 10g: 0.3 – 3 GHz:

Expanded Uncertainty (k=2) 95 %	±21.9 %

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is a handheld measuring device. The DUT supports WLAN 2.4GHz and Bluetooth technologies. The module also supports WLAN 5 GHz, but it is permanently deactivated by the software. Testing was done for Handheld Charge (Type Number: 5811A00, variant #1).

Device Category	Portable
Exposure Environment	General population uncontrolled

2.1 Supported Frequency Bands and Operational Modes

TX Frequency bands	**Modes of Operation**	**Transmitter Frequency Range [MHz]**
	WLAN 2.4 GHz	2412 – 2462
	Bluetooth	2402 – 2480

2.2 Simultaneous transmission

WLAN 2.4GHz and Bluetooth BR can be operated simultaneously.

3. OUTPUT POWER

3.1 Maximum specified conducted output power

From the customer, including tune-up tolerances;

WLAN 2.4GHz	Max Output Power [dBm]
802.11b	12
802.11g	21
802.11n	21

Bluetooth	Max Output Power [dBm]
Bluetooth BR	10
Bluetooth EDR	9
Bluetooth LE	8

3.2 Tested conducted power

Measured conducted output power at transmitting antenna connector;

WLAN 2.4 GHz:

Standard	Transmission mode	Data rate [Mbps]	Output power [dBm]		
			CH 1 2412 MHz	CH 6 2437 MHz	CH 11 2462 MHz
802.11g	OFDM	6	20.13	20.17	20.1

Bluetooth:

Standard	Output power [dBm]		
	CH 0 2402 MHz	CH 39 2441 MHz	CH 78 2480 MHz
Bluetooth BR	9.93	10.63*	10.72*

* Due to maximum Bluetooth TX power set by TX software, the maximum measured output power is higher than maximum specified output power, thus the measured SAR values are conservative.

4. TEST EQUIPMENT

Dasy52 near field scanning system, manufactured by SPEAG was used for SAR testing. The test system consists of high precision robotics system (Staubli), robot controller, computer, near-field probe, probe alignment sensor, and a phantom containing the tissue equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location of maximum electromagnetic field.

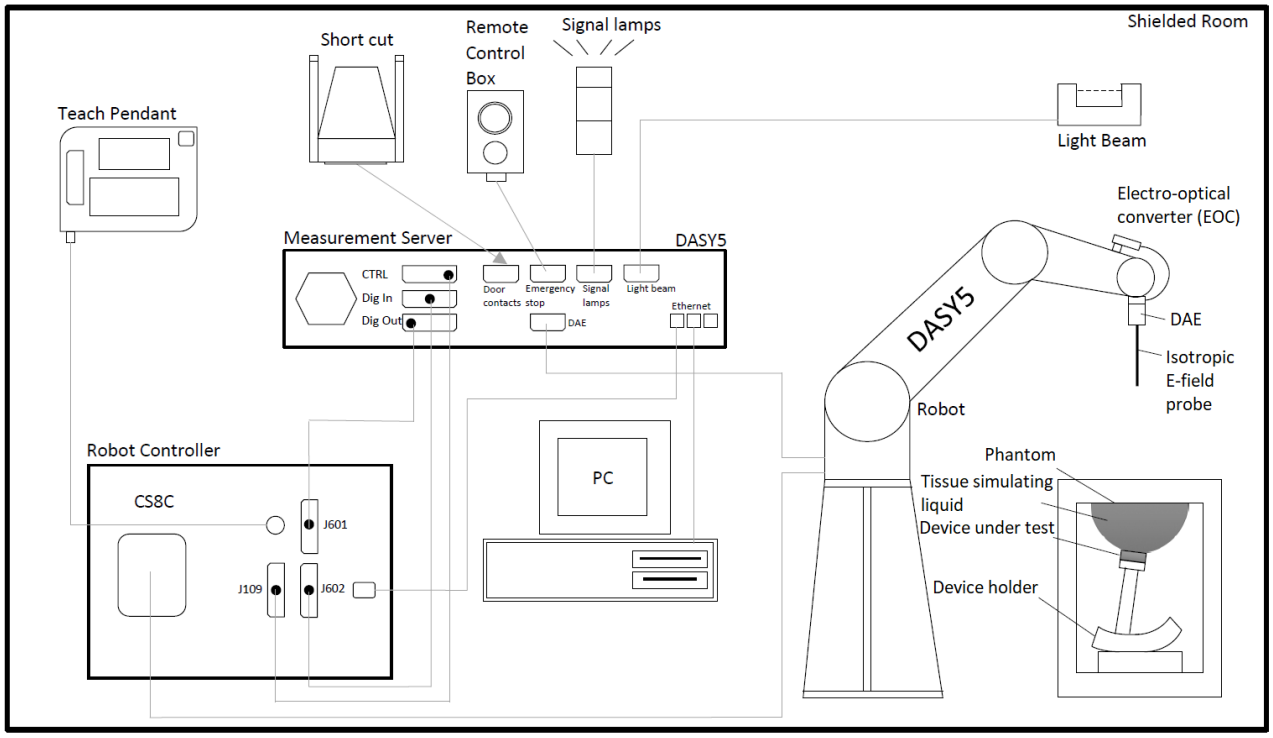


Figure 1 Schematic Laboratory Picture

4.1 Test Equipment List

Main used test system components are listed below. For full equipment list and calibration intervals, please contact the testing laboratory.

Test Equipment	Model	Serial Number	Calibration Date	Calibration Interval (years)
DASY5 Software	52.8.8.1258	-	NA	NA
DAE4, converter	DAE4	705	04/2022	1
Isotropic DOS probe	EX3DV4	3892	04/2022	1
Inline Peak Power Sensor	MA24105A	2102058	11/2022	1
Power Sensor	NRP-Z11	100265	12/2022	1
System validation dipole	D2450V2	729	07/2022	3
Vector Signal Generator	MG3710A	6261911026	02/2022	NA
Amplifier, 800MHz-4200MHz, 10W	10S1G4A	320421	NA	NA
Thermometer	Rotronic, Hygropalm3	21458349	11/2022	1
Verkotan Liquid	WB Head	2023-Feb-15 11_58_28	NA	NA
Verkotan Liquid	WB Head	2023-Feb-20 08_53_49	NA	NA
ELI Phantom, Type: QD OVA 002 AA	2mm Oval Phantom ELI5	1189	NA	NA

4.1.1 Isotropic E-field Probe Type EX3DV4

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to >6 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 µW/g to > 100 mW/g, Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm Tip length: 10 mm Body diameter: 12 mm
Application	General dosimetry up to 6 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms

4.2 Phantoms

ELI Phantom:

The phantom used in SAR tests was an ELI phantom, manufactured by SPEAG. ELI phantom is used for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. The phantom conforms to the requirements of IEC/IEEE 62209-1528 and FCC published RF Exposure KDB Procedures.

4.3 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEC/IEEE 62209-1528 and FCC published RF Exposure KDB Procedures. The dielectric parameters of the used tissue simulants were within ±10% of the recommended values at frequencies under 3GHz and ±5% at frequencies above 3GHz. A liquid compensation algorithm was used in DASY5 with which measured peak average SAR values were corrected for the deviation of used liquid. Depth of the tissue simulant was at least 15.0 cm from the inner surface of the flat phantom.

Tissue simulant liquid Ingredients
Deionized Water, tween, salt

4.4 System Validation Status

Frequency [MHz]	Dipole Type / SN	Probe Type / SN	Calibrated Signal Type	DAE Unit / SN	Dielectric Constant [ε']	Conductivity σ [S/m]	Head tissue simulant
2450	D2450V2 - SN: 758	EX3DV4 - SN: 3892	CW	DAE 4 / 705	39.13	1.7	04/2022

4.5 System Check

Date	Tissue Type	Tissue Temp. [°C]	Frequency [MHz]	Input Power [mW]	Measured SAR_{1g} [W/kg]	1 W Target SAR_{1g} [W/kg]	1 W Normalized SAR_{1g} [W/kg]	Deviation [%]	Plot #
15.02.2023	WB Head	22	2450	250	12.5	52.3	50	-4.40	1
20.02.2023	WB Head	22	2450	250	12.2	52.3	48.8	-6.69	2

4.5.1 Tissue Simulant Verification

				Target		Measured		Deviation	
Date	**Tissue Type**	**Tissue Temp [°C]**	**Frequency [MHz]**	**Dielectric Constant [ε] Target**	**Conductivity σ [S/m] Target**	**Dielectric Constant [ε]**	**Conductivity σ [S/m]**	**ε [%]**	**σ [%]**
15.02.2023	WB Head	22	2412.0	39.27	1.77	41.23	1.61	5.0	-8.9
15.02.2023	WB Head	22	2437.0	39.22	1.79	41.19	1.63	5.0	-9.1
15.02.2023	WB Head	22	2450.0	39.2	1.8	41.17	1.63	5.0	-9.2
15.02.2023	WB Head	22	2462.0	39.18	1.81	41.16	1.64	5.0	-9.4
20.02.2023	WB Head	22	2402.0	39.28	1.76	42.42	1.6	8.0	-8.8
20.02.2023	WB Head	22	2441.0	39.22	1.79	42.36	1.63	8.0	-9.0
20.02.2023	WB Head	22	2450.0	39.2	1.8	42.35	1.64	8.0	-9.0
20.02.2023	WB Head	22	2480.0	39.16	1.83	42.31	1.66	8.0	-9.5

5. TEST PROCEDURE

Testing was carried out in accordance with FCC KDB Publications 447498 D04 Interim General RF Exposure Guidance v01, 248227 D01 802.11 Wi-Fi SAR and RSS-102, Issue 5.

Low, mid and high frequency channels for the configuration with the highest SAR value were tested as per ISED notice 2016-DRS001.

A control software for WLAN and Bluetooth was used to set the DUT to transmit at maximum power.

For Bluetooth the duty cycle of 78% was used. Due to maximum Bluetooth TX power set by TX software, the maximum measured output power is higher than maximum specified output power, thus the measured SAR values are conservative.

The WLAN transmission modes for testing were selected according to largest channel bandwidth configuration, lowest order modulation and lowest data rate.
WLAN 2.4GHz was tested with 802.11g standard with data rate of 6Mbit/s. The duty cycle of 100 % was used.

5.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy system.

Device holder supplied by SPEAG

5.2 Test Positions

5.2.1 Body-worn/Extremity Configuration, 0mm separation distance

The device was placed on the device holder and lifted towards the phantom until the distance between the phantom and the device was 0mm. The device was tested with 0mm separation distance from all six sides of the DUT.

5.3 Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

5.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy52 are all based on the modified Quadratic Shepard's method (Robert J. Renka," Multivariate Interpolation of Large Sets of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).
The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighboring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

6. MEASUREMENT UNCERTAINTY

DASY5 Uncertainty Budget
According to IEC/IEEE 62209-1528
(Frequency band: 300MHz - 3GHz range)

Symbol	Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)
Measurement System Errors								
CF	Probe Calibration	±12.0%	N	√2	1	1	±6.0%	±6.0%
CF_{drift}	Probe Calibration Drift	±1.7%	R	√3	1	1	±1.0%	±1.0%
LIN	Probe Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%
BBS	Broadband Signal	±3.0%	R	√3	1	1	±1.7%	±1.7%
ISO	Probe Isotropy	±7.6%	R	3	1	1	±4.4%	±4.4%
DAE	Data Acquisition	±0.3%	N	1	1	1	±0.3%	±0.3%
AMB	RF Ambient	±1.8%	N	1	1	1	±1.8%	±1.8%
Δ_{syz}	Probe Positioning	±3.9%	N	1	0.14	0.14	±0.5%	±0.5%
DAT	Data Processing	±1.2%	N	1	1	1	±1.2%	±1.2%
Phantom and Device Errors								
LIQ(σ)	Conductivity (meas.)[DAK]	±2.5%	N	√1	0.78	0.71	±2.0%	±1.8%
$LIQ(T_\sigma)$	Conductivity (temp.)[BB]	±3.3%	R	√3	0.78	0.71	±1.5%	±1.4%
EPS	Phantom Permittivity	±14.0%	R	3	0	0	±0%	±0%
DIS	Distance DUT - TSL	±2.0%	N	1	2	2	±4.0%	±4.0%
D_{xyz}	Device Positioning (±0.5mm)	±1.0%	N	1	1	1	±1.0%	±1.0%
H	Device Holder	±3.6%	N	√1	1	1	±3.6%	±3.6%
MOD	DUT Modulation[m]	±2.4%	R	√3	1	1	±1.4%	±1.4%
TAS	Time-average SAR	±2.6%	R	3	1	1	±1.5%	±1.5%
RF_{drift}	DUT drift	±2.5%	N	1	1	1	±2.5%	±2.5%
VAL	Val Antenna Unc.[val]	±0.0%	N	1	1	1	±0%	±0%
RF_{in}	Unc. Input Power[val]	±0.0%	N	1	1	1	±0%	±0%
Correction to the SAR results								
C(ε, σ)	Deviation to Target	±1.9%	N	√1	1	0.84	±1.9%	±1.6%
C(R)	SAR scaling[p]	±0%	R	3	1	1	±0%	±0%
u(ΔSAR)	Combined Uncertainty						±11.0%	±10.9%
U	**Expanded Uncertainty**						±22.1%	±21.9%

7. TEST RESULTS

7.1 SAR Results for Body Exposure Condition with 0mm separation

2.4GHz WLAN:

Mode	Data Rate [Mbps]	Frequency [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR_{1g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Reported SAR_{1g} [W/kg]	Plot #
802.11g	6	2437	6	Front	21	20.27	0.91	-0.2	1.18	1:1	1.08	3
802.11g	6	2437	6	Back	21	20.27	0.02	0.88	1.45	1:1	0.03	
802.11g	6	2437	6	Left	21	20.27	0.66	0.57	1.35	1:1	0.89	
802.11g	6	2437	6	Right	21	20.27	0.002	-0.21	1.18	1:1	0.003	
802.11g	6	2437	6	Top	21	20.27	0.005	0.28	1.26	1:1	0.007	
802.11g	6	2437	6	Bottom	21	20.27	0.012	0.07	1.18	1:1	0.01	
802.11g	6	2412	1	Front	21	20.13	0.87	-0.09	1.22	1:1	1.06	
802.11g	6	2462	11	Front	21	20.1	0.67	0.46	1.37	1:1	0.91	
802.11g	6	2437	6	Front, Repeat	21	20.27	0.90	-0.06	1.18	1:1	1.06	
802.11g	6	2412	1	Front, Repeat	21	20.13	0.85	-0.03	1.22	1:1	1.04	

*Larger than 5% drifts included to scaling factors

Bluetooth:

Mode	Data Rate [Mbps]	Frequency [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR_{1g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle [%]	Reported SAR_{1g} [W/kg]	Plot #
Bluetooth	1	2480	78	Front	10	10.72	0.113	-0.15	1.00	78	0.11	
Bluetooth	1	2480	78	Back	10	10.72	0.015	0.04	1.00	78	0.015	
Bluetooth	1	2480	78	Left	10	10.72	0.0001	0**	1.00	78	0.0001	
Bluetooth	1	2480	78	Right	10	10.72	0.054	-0.07	1.00	78	0.05	
Bluetooth	1	2480	78	Top	10	10.72	0.0015	0.46	1.11	78	0.002	
Bluetooth	1	2480	78	Bottom	10	10.72	0.00004	0.43	1.10	78	0.00005	
Bluetooth	1	2402	0	Front	10	9.93	0.11	0.03	1.02	78	0.12	4
Bluetooth	1	2441	39	Front	10	10.63	0.11	-0.23	1.05	78	0.12	

*Larger than 5% drifts included to scaling factors
** Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable.

7.2 SAR Results for Extremity Condition with 0mm separation

2.4GHz WLAN:

Mode	Data Rate [Mbps]	Frequency [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR_{10g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Reported SAR_{10g} [W/kg]	Plot #
802.11g	6	2437	6	Front	21	20.27	0.41	-0.2	1.18	1:1	0.49	3
802.11g	6	2437	6	Back	21	20.27	0.01	0.88	1.45	1:1	0.01	
802.11g	6	2437	6	Left	21	20.27	0.32	0.57	1.35	1:1	0.43	
802.11g	6	2437	6	Right	21	20.27	0.0005	-0.21	1.18	1:1	0.001	
802.11g	6	2437	6	Top	21	20.27	0.002	0.28	1.26	1:1	0.003	
802.11g	6	2437	6	Bottom	21	20.27	0.007	0.07	1.18	1:1	0.01	
802.11g	6	2412	1	Front	21	20.13	0.39	-0.09	1.22	1:1	0.48	
802.11g	6	2462	11	Front	21	20.1	0.30	0.46	1.37	1:1	0.42	

*Larger than 5% drifts included to scaling factors

Bluetooth:

Mode	Data Rate [Mbps]	Frequency [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR_{10g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle [%]	Reported SAR_{10g} [W/kg]	Plot #
Bluetooth	1	2480	78	Front	10	10.72	0.053	-0.15	1.00	78	0.05	
Bluetooth	1	2480	78	Back	10	10.72	0.008	0.04	1.00	78	0.008	
Bluetooth	1	2480	78	Left	10	10.72	0.00001	0**	1.00	78	0.00001	
Bluetooth	1	2480	78	Right	10	10.72	0.027	-0.07	1.00	78	0.03	
Bluetooth	1	2480	78	Top	10	10.72	0.0005	0.46	1.11	78	0.0005	
Bluetooth	1	2480	78	Bottom	10	10.72	0.00001	0.43	1.10	78	0.00001	
Bluetooth	1	2402	0	Front	10	9.93	0.054	0.03	1.02	78	0.06	4
Bluetooth	1	2441	39	Front	10	10.63	0.051	-0.23	1.05	78	0.05	

*Larger than 5% drifts included to scaling factors
** Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable.

7.3 IEC 62209-2 AMD1:2019

According to IEC 62209-2 AMD1:2019, the zoom scan complies if the peak spatial-average SAR is below 0.1 W/kg, or if the following criteria is met:

1. The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak is larger than the horizontal grid step.

2. Ratio of SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x-y location of the measured maximum is at least 30%.

Zoom scan compliance according to IEC 62209-2 AMD1:2019 is automatically verified by DASY5 software and all zoom scans in this test report do pass the criteria. The smallest horizontal distance and Ratio between measurement points M2 and M1 of the highest SAR results is available in Appendix B.

7.4 Simultaneous Transmission Analysis

Simultaneous transmission analysis for the maximum WLAN SAR and the maximum Bluetooth SAR is in the table below. Direct summation of SAR results was performed.

Body SAR:

Exposure Condition	Body SAR_{1g} [W/kg]					
Test Position	Front	Back	Left	Right	Top	Bottom
Maximum WLAN 2.4GHz SAR	1.08	0.03	0.89	0.003	0.007	0.01
Maximum Bluetooth SAR	0.12	0.015	0.0001	0.05	0.002	0.00005
SAR Summation:	1.2	0.05	0.89	0.05	0.01	0.01

Extremity SAR:

Exposure Condition	Extremity SAR_{10g} [W/kg]					
Test Position	Front	Back	Left	Right	Top	Bottom
Maximum WLAN 2.4GHz SAR	0.49	0.01	0.43	0.001	0.003	0.01
Maximum Bluetooth SAR	0.06	0.008	0.00001	0.03	0.0005	0.00001
SAR Summation:	0.55	0.02	0.43	0.03	0.004	0.01

APPENDIX A: SYSTEM CHECK SCAN

Plot 1

Date/Time: 15.02.2023 12.10.26

Test Laboratory: Verkotan Oy

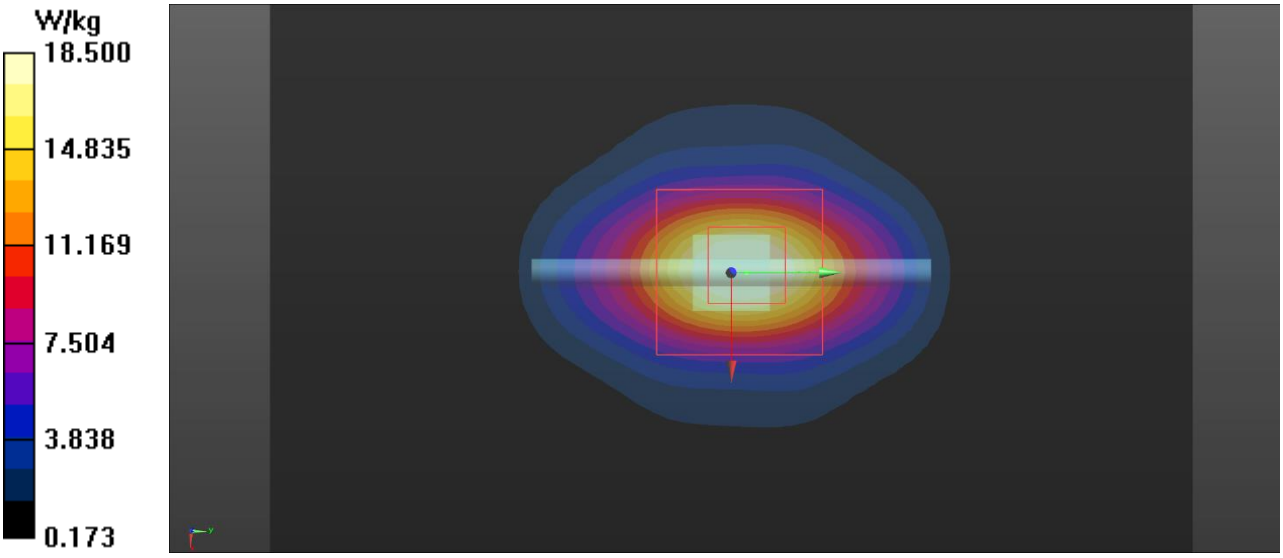
DUT: D2450V2 - SN729; Type: D2450V2; Serial: SN729

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.635 S/m; ε_r = 41.172; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.66, 7.66, 7.66) @ 2450 MHz; Calibrated: 12.04.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn705; Calibrated: 12.04.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/System check/Area Scan (41x61x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 19.1 W/kg
Configuration/System check/Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=7.5mm
Reference Value = 111.7 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 22.3 W/kg
SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.87 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 39.1%
Maximum value of SAR (measured) = 18.5 W/kg



Plot 2

Date/Time: 20.02.2023 9.11.15

Test Laboratory: Verkotan Oy

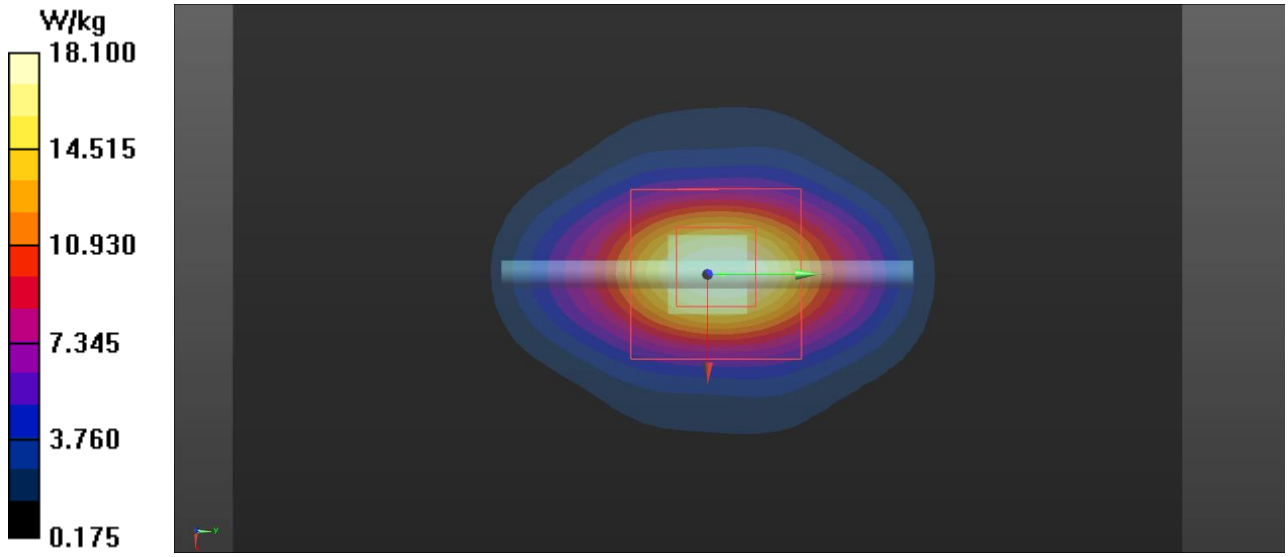
DUT: D2450V2 - SN729; Type: D2450V2; Serial: SN729

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.637 S/m; ε_r = 42.353; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.66, 7.66, 7.66) @ 2450 MHz; Calibrated: 12.04.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn705; Calibrated: 12.04.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/System check/Area Scan (41x61x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 18.2 W/kg
Configuration/System check/Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=7.5mm
Reference Value = 109.6 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 21.6 W/kg
SAR(1 g) = 12.2 W/kg; SAR(10 g) = 5.73 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 9.5 mm
Ratio of SAR at M2 to SAR at M1 = 39%
Maximum value of SAR (measured) = 18.1 W/kg



APPENDIX B: MEASUREMENT SCANS

Plot 3

Date/Time: 15.02.2023 13.15.10

Test Laboratory: Verkotan Oy

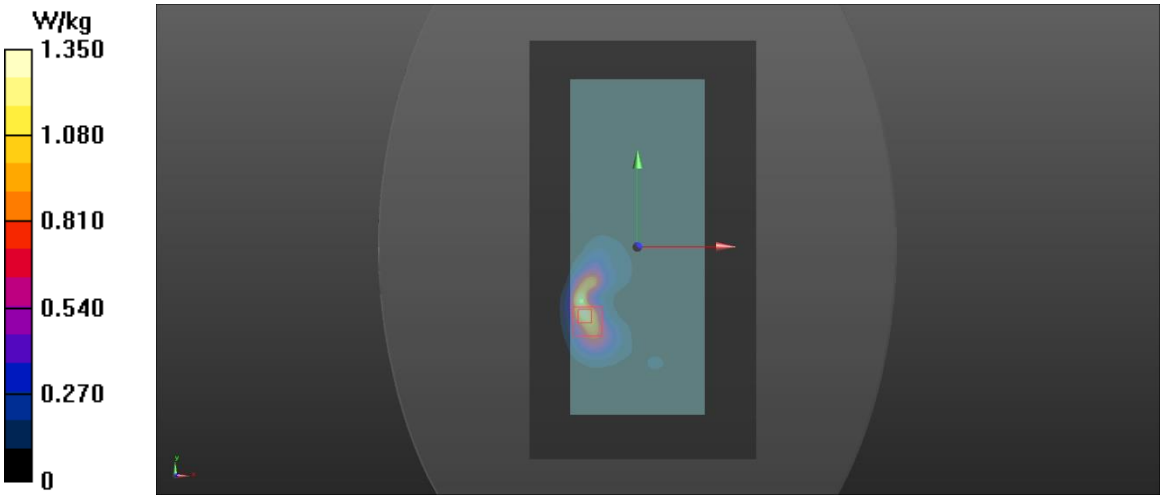
DUT: Handheld Messgerät

Communication System: UID 0, WLAN 2.4 (0); Communication System Band: WLAN2.4GHz; Frequency: 2437 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.625 S/m; ε_r = 41.193; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.66, 7.66, 7.66) @ 2437 MHz; Calibrated: 12.04.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
  - Electronics: DAE4 Sn705; Calibrated: 12.04.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

WLAN 2.4GHz CH 6 Front 0mm/Zoom Scan (8x10x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.03 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 1.87 W/kg
SAR(1 g) = 0.911 W/kg; SAR(10 g) = 0.411 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 5.8 mm
Ratio of SAR at M2 to SAR at M1 = 48.4%
Maximum value of SAR (measured) = 1.38 W/kg
WLAN 2.4GHz CH 6 Front 0mm/Area Scan (141x261x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.35 W/kg



Plot 4

Date/Time: 20.02.2023 15.01.27

Test Laboratory: Verkotan Oy

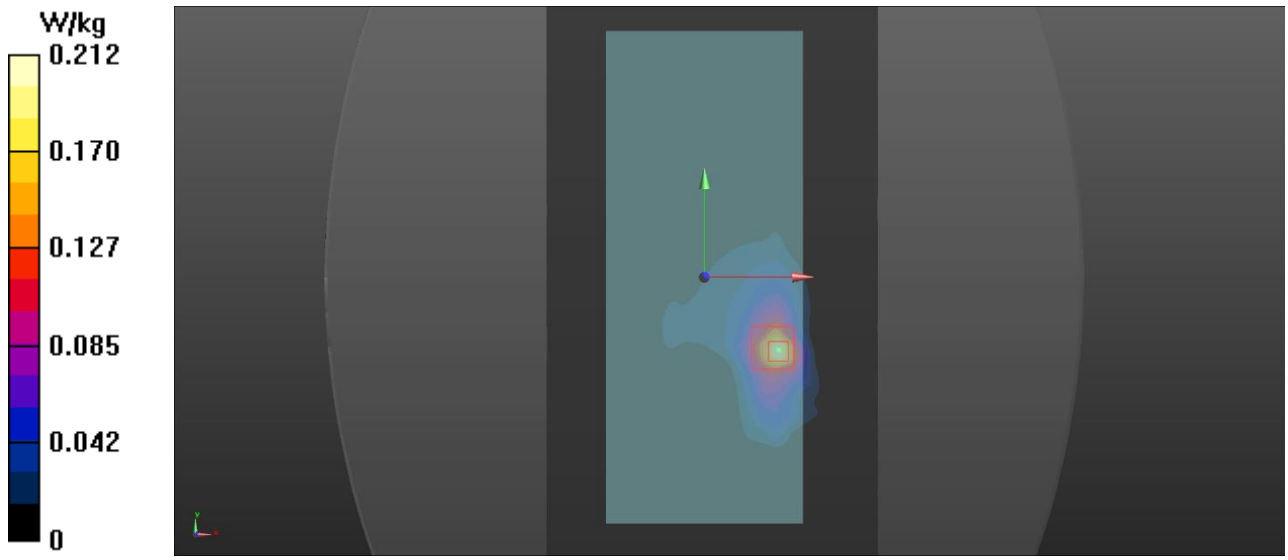
DUT: Handheld Messgerät

Communication System: UID 0, Bluetooth (0); Communication System Band: Bluetooth; Frequency: 2402 MHz;
Communication System PAR: 1.079 dB;
Medium parameters used (interpolated): f = 2402 MHz; σ = 1.604 S/m; ε_r = 42.424; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

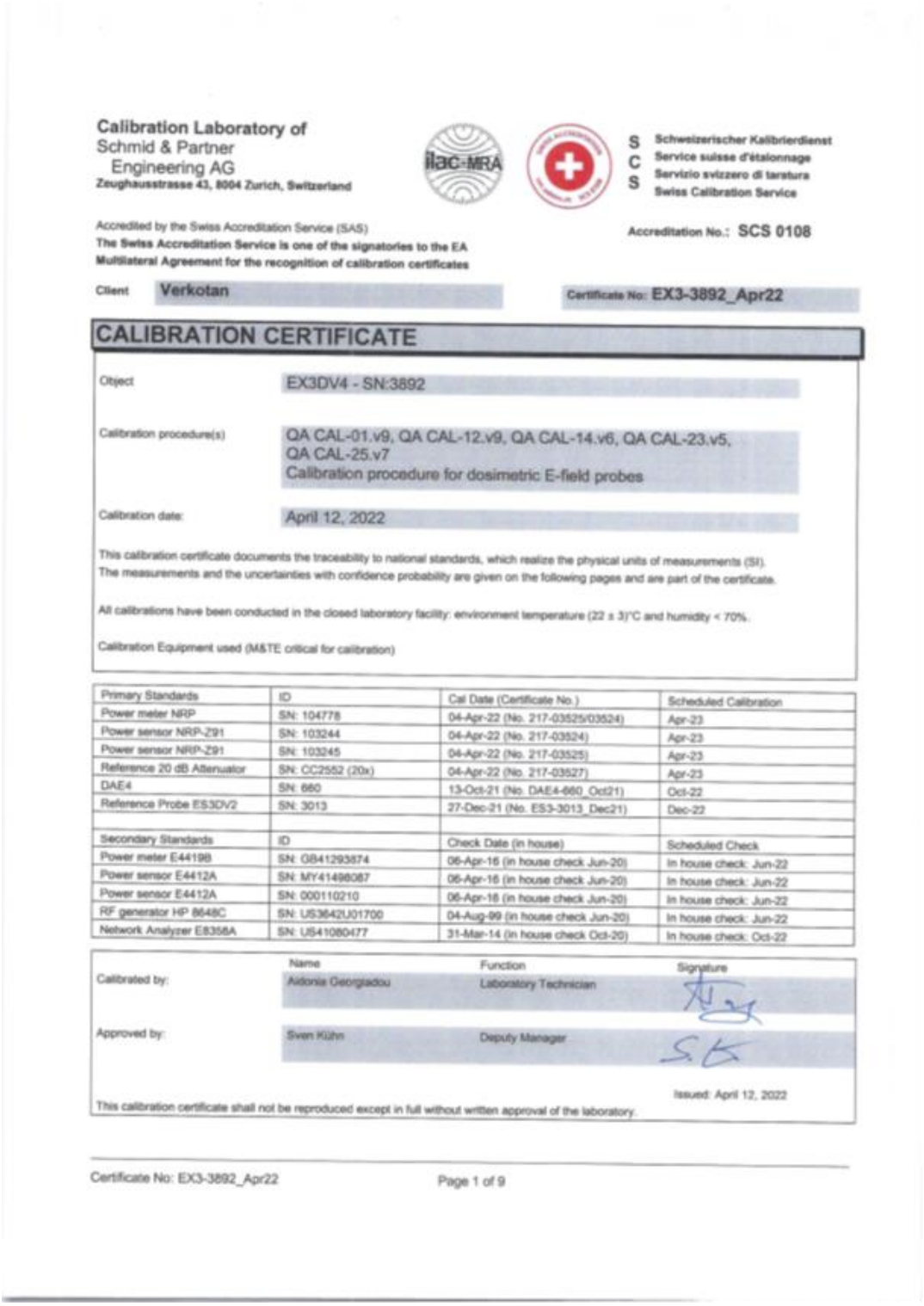
DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.66, 7.66, 7.66) @ 2402 MHz; Calibrated: 12.04.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn705; Calibrated: 12.04.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Bluetooth CH 0 Front 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.842 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.232 W/kg
SAR(1 g) = 0.114 W/kg; SAR(10 g) = 0.054 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 48%
Maximum value of SAR (measured) = 0.181 W/kg
Bluetooth CH 0 Front 0mm/Area Scan (141x261x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.212 W/kg



APPENDIX C: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS



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

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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: Verkotan

Certificate No: EX3-3892_Apr22

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3892

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7
Calibration procedure for dosimetric E-field probes

Calibration date: April 12, 2022

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	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: CC2552 (20x)	04-Apr-22 (No. 217-03527)	Apr-23
DAE4	SN: 660	13-Oct-21 (No. DAE4-660_Oct21)	Oct-22
Reference Probe ES3DV2	SN: 3013	27-Dec-21 (No. ES3-3013_Dec21)	Dec-22
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-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Aidonia Georgiadou	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: April 12, 2022

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

Certificate No: EX3-3892_Apr22 Page 1 of 9

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3892

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m)²)[A]	0.47	0.38	0.47	± 10.1 %
DCP (mV)[B]	102.0	105.5	101.6	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	154.3	± 3.0 %	± 4.7 %
		Y	0.0	0.0	1.0		165.8		
		Z	0.0	0.0	1.0		158.8		

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%.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3892

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-148.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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

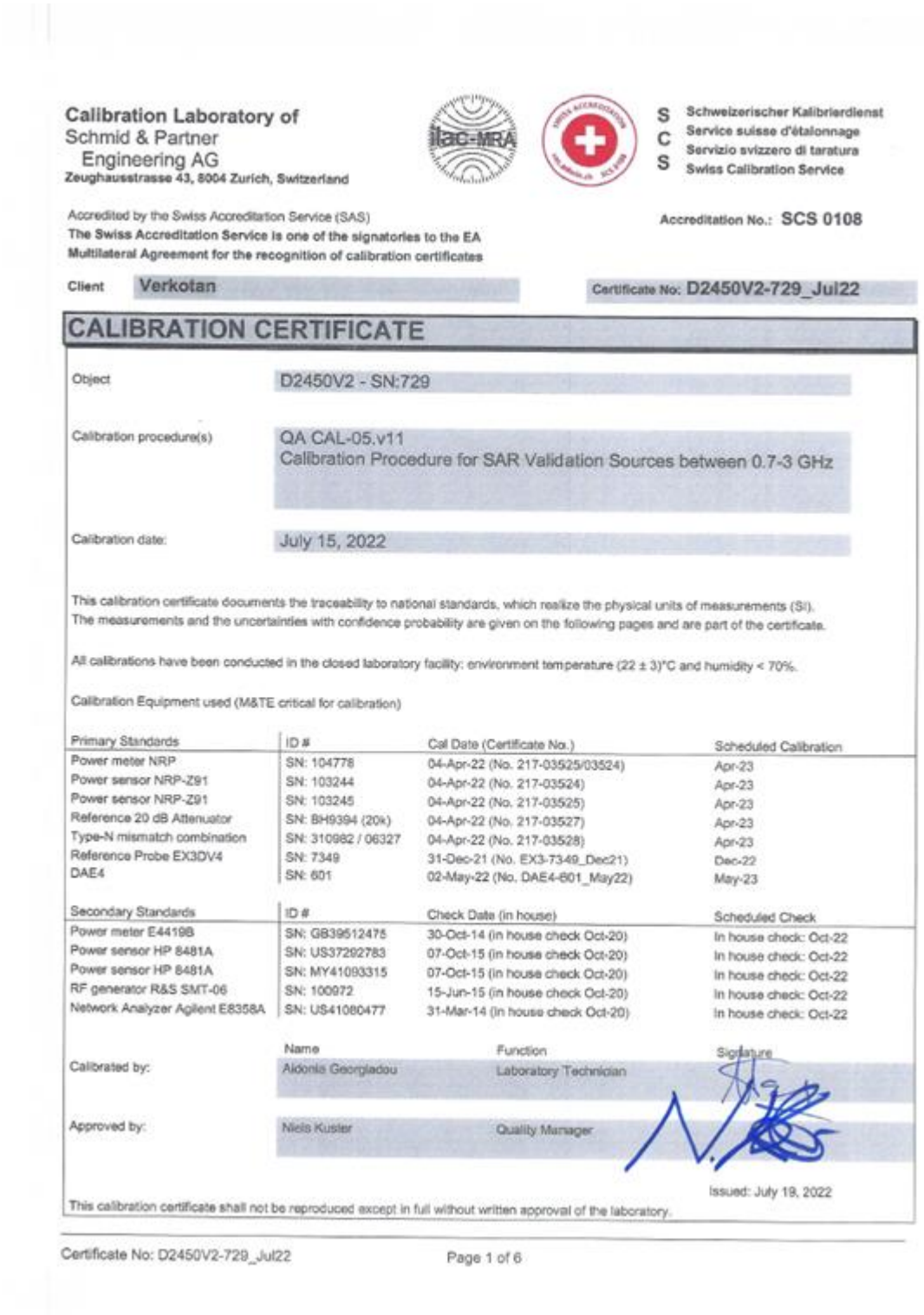
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3892

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)
600	42.7	0.88	10.43	10.43	10.43	0.10	1.25	± 13.3 %
750	41.9	0.89	10.26	10.26	10.26	0.48	0.80	± 12.0 %
900	41.5	0.97	9.95	9.95	9.95	0.36	0.91	± 12.0 %
1900	40.0	1.40	8.31	8.31	8.31	0.29	0.86	± 12.0 %
2450	39.2	1.80	7.66	7.66	7.66	0.33	0.90	± 12.0 %
2600	39.0	1.96	7.55	7.55	7.55	0.39	0.90	± 12.0 %
4400	36.9	3.84	6.08	6.08	6.08	0.40	1.60	± 13.1 %
4800	36.4	4.25	5.65	5.65	5.65	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else 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.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] 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 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

APPENDIX D: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS



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

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Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client Verkotan

Certificate No: D2450V2-729_Jul22

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:729
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	July 15, 2022

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	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	02-May-22 (No. DAE4-601_May22)	May-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Aldonia Georgiadou	Laboratory Technician	
Approved by:	Niels Kuster	Quality Manager	

Issued: July 19, 2022

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Certificate No: D2450V2-729_Jul22 Page 1 of 6

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	
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	37.9 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 16.5 % (k=2)**