SAR Compliance Test Report

Date of Report	18/04/2023	**Client's Contact person:**	Fredrik Eriksson
Number of pages:	33	**Responsible Test engineer:**	Kalle Orava
Testing laboratory:	**Verkotan Oy** Elektroniikkatie 17 90590 Oulu Finland	**Client:**	**Husqvarna AB** Drottninggatan 2 SE-561 82 Huskvarna Sweden
Tested device	HP500C-1, HP500BT-1		
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:

18.04.2023

Miia Nurkkala

Digitaalinen allekirjoittaja: Miia Nurkkala
Päiväys: 2023.04.18 08:49:28 +03'00'

Laboratory Manager

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (DUT):

Product:	Hearing protectors
Manufacturer:	Husqvarna AB
Model:	HP500C-1, HP500BT-1
Serial Number:	R323 (HP500C-1), 330 (HP500BT-1)
FCC ID Number:	ZASHP500
ISED ID Number:	23307-HP500
DUT Number:	21397 (HP500BT-1), 21396 (HP500C-1), 21398 (Conducted sample)
Battery Type used in testing:	Li-Ion Battery
State of the Sample:	Production sample

Testing information:

Testing performed:	25.01.2023 – 31.01.2023
Notes:	DUT includes Qualcomm QCC5144 and RTX1090 SoC's
Document history:	-
Document ID:	FCC ISED SAR report_Husqvarna ID5577_31.03.2023.docx
Temperature °C	22±2 / Controlled
Humidity RH%	30±20 / Controlled
Measurement performed by:	Kalle Orava
FCC Test Firm Designation Number:	FI0005
ISED Company Number:	22218

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1.2 Maximum Results

The maximum reported* SAR values for Head/Body-worn 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 and Health Canada's RF exposure guideline, Safety Code 6 for Head/Body SAR_{1g} is 1.6 W/kg.

1.2.1 Standalone SAR

System	Highest Reported* SAR_{1g}(W/kg) in Body-Worn Exposure Condition, 0mm separation distance	Result
DECT	**0.041**	**PASS**
Bluetooth (Basic rate GFSK)	**0.14**	**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	Result
DECT + Bluetooth (Basic rate GFSK)	**0.181**	**PASS**

1.2.3 Maximum Drift

Maximum Drift During Measurements	0.91 dB*

*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 %

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2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is a hearing protector headset. The device supports DECT and Bluetooth technologies. There is one TX antenna for Bluetooth, and two antennas for DECT. DECT uses only one TX antenna at a time.

The DUT contains Qualcomm QCC5144 and RTX1090 SoC for Bluetooth and DECT respectively.

This SAR report applies for both HP500C-1 and HP500BT-1 models. Only difference between the models is DECT operational mode, which is present in the HP500C-1. Both models were used for SAR measurements.

DECT and Bluetooth SAR was fully measured from HP500C-1 and then highest Bluetooth conducted power channel was verified for compliance on the HP500BT-1 model using all of the test positions.

For testing Bluetooth, basic rate was used with the lowest data rate of 1 Mb/s, as it can be expected to have highest power.

Device Category	Portable
Exposure Environment	General population uncontrolled

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2.1 Supported Frequency Bands and Operational Modes

TX Frequency bands	Modes of Operation	Transmitter Frequency Range [MHz]
	DECT	1921.536 – 1928.448
	Bluetooth	2402 – 2480

2.2 Simultaneous Transmission

DECT and Bluetooth can be operated simultaneously.

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3. OUTPUT POWER

3.1 Maximum specified conducted output power

From the customer, including tune-up tolerances;

Bluetooth	Data Rate	Max Output Power [dBm]
Bluetooth	1 Mb/s (Basic rate GFSK)	13

DECT	Max Output Power [dBm]
DECT	20

3.2 Tested conducted power

Measured conducted output power from soldered cable, from separate conducted sample.

Bluetooth:

Output power [dBm]			
Data Rate	**CH 0 2402 MHz**	**CH 39 2441 MHz**	**CH 78 2480 MHz**
1 Mb/s (Basic rate GFSK)	10.61	11.94	9.98

DECT:

Output power [dBm]		
CH 0 1928.448 MHz	**CH 2 1924.992 MHz**	**CH 4 1921.536 MHz**
19.18	19.19	19.17

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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.

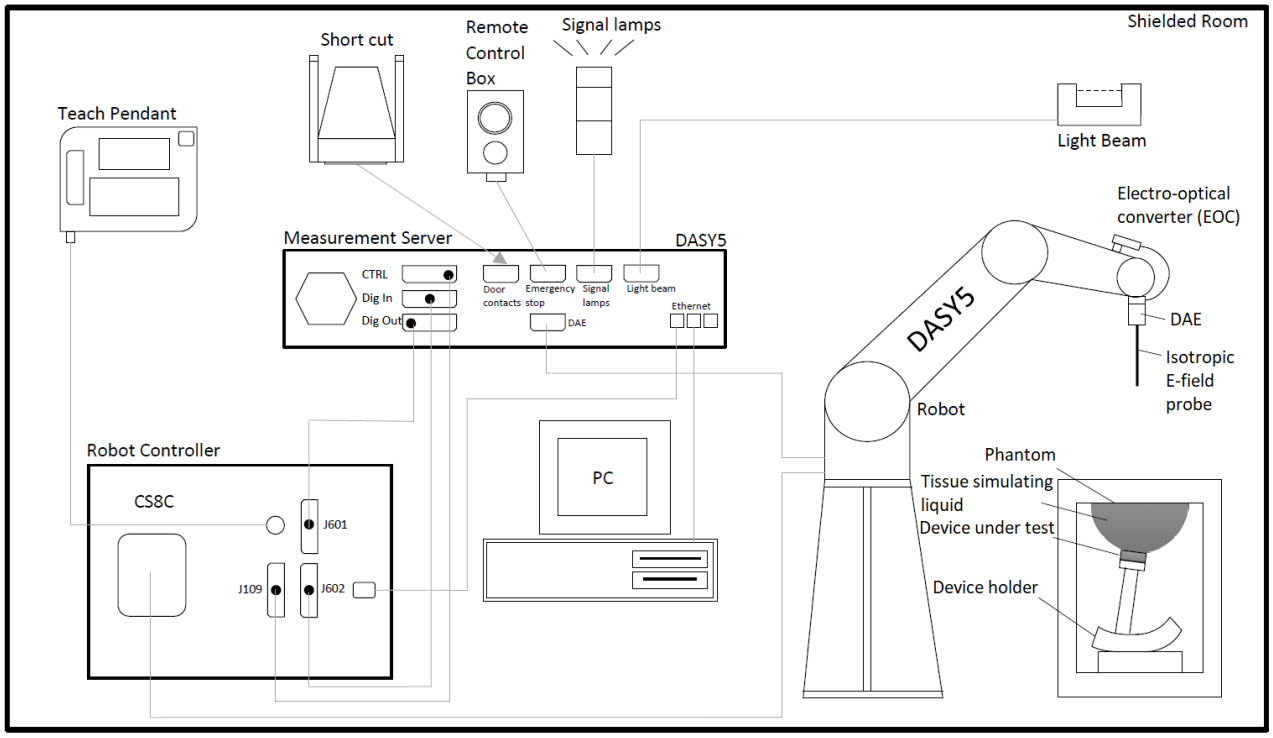

Figure 1 Schematic Laboratory Picture

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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
DASY5 Software	52.8.8.1258	-	NA
Isotropic DOS probe	EX3DV4	3852	10/2022
Inline Peak Power Sensor	MA24105A	2102058	11/2022
DAE4, converter	DAE4	710	10/2022
Vector Signal Generator	MG3710A	6261911026	02/2022
Amplifier, 800MHz-4200MHz	10S1G4A	320421	NA
System validation dipole	D1900V2	511	03/2020
System validation dipole	D2450V2	729	07/2022
Power Sensor	NRP-Z11	100265	12/2022

Dipole calibration period supporting data:

		Measured on 10/2022			Calibrated		
Dipole and serial number	Frequency [MHz]	Return loss [dB]	Impedance [Ω]		Return loss [dB]	Impedance [Ω]	
D1900V2-SN:511	1900	-23.8	48.5	6.2	-21.37	52.9	8

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 D
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

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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. 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

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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]	Validation Done
1900	D1900V2 / 511	EX3DV4 / 3852	CW	DAE 4 / 710	40.05	1.39	11/2022
2450	D2450V2 / 758	EX3DV4 / 3852	CW	DAE 4 / 710	40.46	1.75	11/2022

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 #
25.01.2023	WB Head	22	1900	250	9.18	37.1	36.72	-1.0	1
26.01.2023	WB Head	22	2450	250	12.1	52.3	48.4	-7.46	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 [%]
25.01.2023	WB Head	22	1881.792	40.0	1.4	40.01	1.31	0.0	-6.3
25.01.2023	WB Head	22	1888.704	40.0	1.4	40.01	1.31	0.0	-6.1
25.01.2023	WB Head	22	1897.3	40.0	1.4	40.01	1.32	0.0	-5.9
25.01.2023	WB Head	22	1900.0	40.0	1.4	40.0	1.32	-0.0	-5.7
25.01.2023	WB Head	22	1921.536	40.0	1.4	39.96	1.33	-0.1	-4.8
25.01.2023	WB Head	22	1924.992	40.0	1.4	39.95	1.33	-0.1	-4.7
25.01.2023	WB Head	22	1928.448	40.0	1.4	39.94	1.33	-0.1	-4.7
25.01.2023	WB Head	22	2402.0	39.28	1.76	39.21	1.61	-0.2	-8.2
25.01.2023	WB Head	22	2441.0	39.22	1.79	39.16	1.64	-0.1	-8.5
25.01.2023	WB Head	22	2450.0	39.2	1.8	39.13	1.64	-0.2	-8.6
25.01.2023	WB Head	22	2480.0	39.16	1.83	39.1	1.67	-0.2	-9.0

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5. TEST PROCEDURE

Testing was carried out in accordance with FCC KDB Publications 447498 D04 Interim General RF Exposure Guidance v01 and RSS-102 Issue 5. A control software was used for both Bluetooth and DECT, to set the DUT transmit at maximum power. Normal operational duty cycle for DECT is 8.3%, which was also used during SAR measurements.

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

5.1 Test Positions

5.1.1 Body-worn Configuration, 0mm separation distance, inside of the ear cup

Body SAR was tested from the inside of the device's ear cups. The device was placed on the top of a Rohacell and lifted towards the phantom until the distance between the phantom and the device was 0mm.

Photos of the test positions are presented in appendix A

5.1.2 Body-worn Configuration, 0mm separation distance, outside of the ear cup

Body SAR was tested from the outside of the device's ear cups. The device was placed on the top of a Rohacell and lifted towards the phantom until the distance between the phantom and the device was 0mm.

Photos of the test positions are presented in appendix A

5.2 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.

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5.3 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.

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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%

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7. TEST RESULTS

7.1 SAR Results for Body Exposure Condition with 0mm separation

7.1.1 DECT

Standard	Channel	Frequency [MHz]	Antenna	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measured SAR1g [W/kg]	Power Drift [dB]	Duty Cycle [%]	Scaling Factor	Reported SAR1g [W/kg]	Plot #
DECT	4	1921.536	1	20	19.17	Right Ear, outside	0.018	0.37	8.3	1.32	0.023	
DECT	2	1924.992	1	20	19.19	Right Ear, outside	0.016	0.43	8.3	1.33	0.021	
DECT	0	1928.448	1	20	19.18	Right Ear, outside	0.014	-0.31	8.3	1.30	0.018	
DECT	4	1921.536	2	20	19.17	Left Ear, outside	0.023	0.2	8.3	1.21	0.028	
DECT	2	1924.992	2	20	19.19	Left Ear, outside	0.034	0.06	8.3	1.21	0.041	3
DECT	0	1928.448	2	20	19.18	Left Ear, outside	0.028	0.63	8.3	1.40	0.039	
DECT	2	1924.992	1	20	19.19	Right Ear, inside	0*	N/A**	8.3	1.21	0*	
DECT	2	1924.992	2	20	19.19	Left Ear, inside	0*	N/A**	8.3	1.21	0*	

*Due to low e-field generated by DUT, the measurements are not applicable
**Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable

7.1.2 Bluetooth

Standard	Channel	Frequency [MHz]	Data Rate [Mbps]	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measured SAR1g [W/kg]	Power Drift [dB]	Duty Cycle [%]	Scaling Factor	Reported SAR1g [W/kg]	Plot #
BT Basic rate GFSK	0	2402	1	13	10.61	Left Ear, outside	0.067	0.14	100	1.73	0.12	
BT Basic rate GFSK	39	2441	1	13	11.94	Left Ear, outside	0.090	-0.76	100	1.52	0.14	4
BT Basic rate GFSK	78	2480	1	13	9.98	Left Ear, outside	0.0061	0.91	100	2.47	0.02	
BT Basic rate GFSK	39	2441	1	13	11.94	Left Ear, inside	0.0241	N/A*	100	1.85	0.04	

*Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable

7.1.3 Bluetooth (Bluetooth only, DUT 21397)

Standard	Channel	Frequency [MHz]	Data Rate [Mbps]	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measured SAR1g [W/kg]	Power Drift [dB]	Duty Cycle [%]	Scaling Factor	Reported SAR1g [W/kg]	Plot #
BT Basic rate GFSK	39	2441	1	13	11.94	Left Ear, outside	0.072	-0.15	100	1.28	0.09	5
BT Basic rate GFSK	39	2441	1	13	11.94	Left Ear, inside	0.013	-0.63	100	1.48	0.02	

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7.2 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 C.

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7.3 Simultaneous Transmission Analysis

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

	Exposure Condition	Body SAR_{1g} [W/kg]	
	Test Position	**Outside of the ear cups**	**Inside of the ear cups**
	BT Basic rate GFSK	0.14	0.04
	DECT	0.041	0*
Maximum BT Basic rate GFSK		**0.14**	**0.04**
Maximum DECT		**0.041**	**0***
SAR Summation		**0.181**	

*Due to low e-field generated by DUT, the measurements are not applicable

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APPENDIX A: PHOTOS OF THE DUT

Size of the DUT is: 200mm x 200mm.

Figure 2. Left ear cup, outside, 0mm separation distance.

Figure 3. Left ear cup, inside, 0mm separation.

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Figure 4. Right ear cup, inside, 0mm separation distance.

Figure 5. Right ear cup, outside, 0mm separation distance.

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APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 25.01.2023 13.24.22

Test Laboratory: Verkotan Oy

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:511

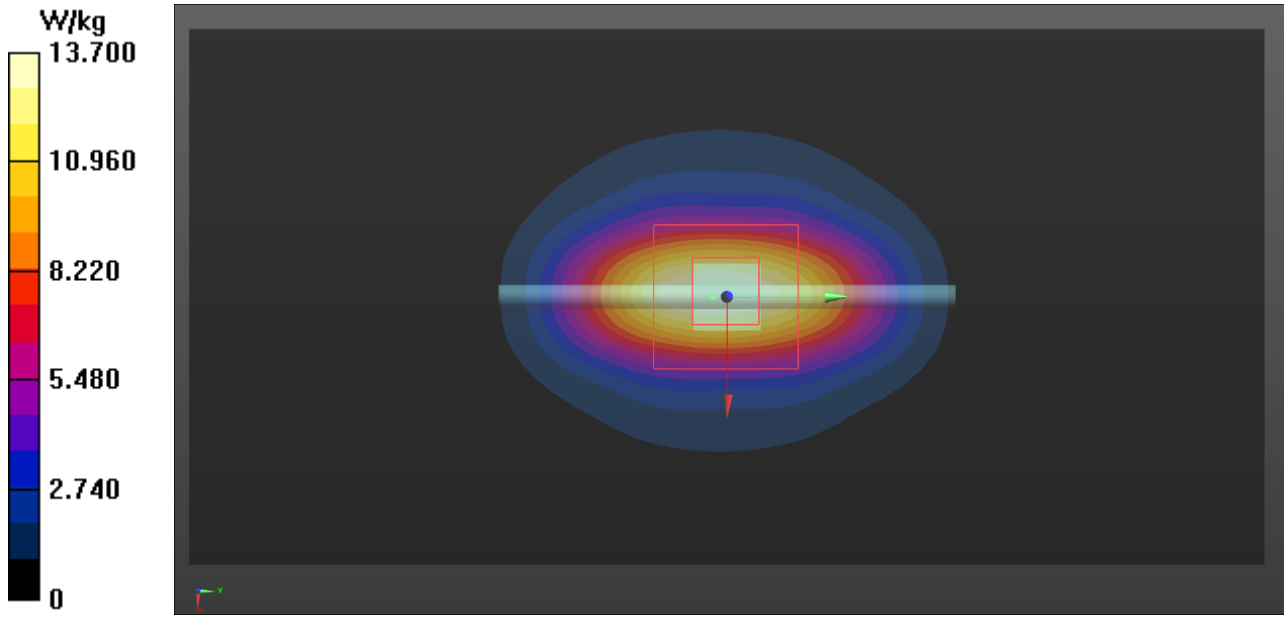
Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 1900 MHz; σ = 1.321 S/m; ε_r = 39.999; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.72, 7.72, 7.72) @ 1900 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check/Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=7.5mm
Reference Value = 106.2 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 15.6 W/kg
SAR(1 g) = 9.18 W/kg; SAR(10 g) = 4.78 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 13.3 W/kg

Configuration/System check/Area Scan (41x81x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 13.7 W/kg



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Plot 2

Date/Time: 26.01.2023 14.00.19

Test Laboratory: Verkotan Oy

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:729

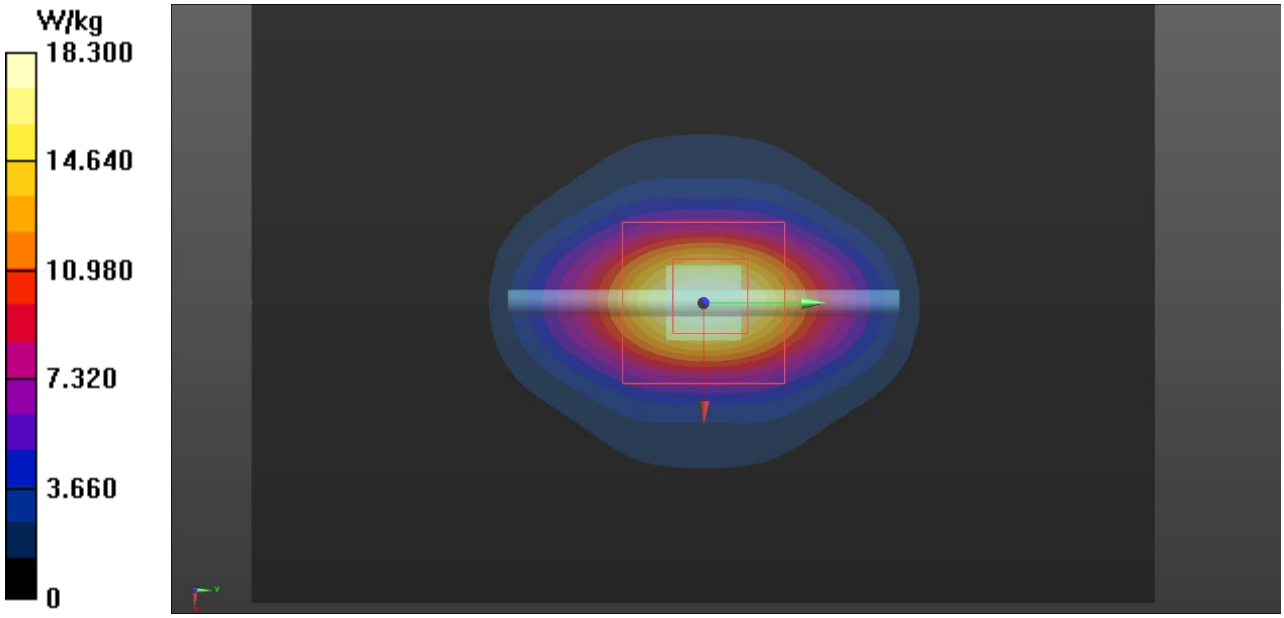
Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.645 S/m; ε_r = 39.133; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.48, 7.48, 7.48) @ 2450 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check/Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=7.5mm
Reference Value = 111.1 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 21.6 W/kg
SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.71 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 18.2 W/kg

Configuration/System check/Area Scan (41x61x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 18.3 W/kg



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APPENDIX C: MEASUREMENT SCANS

Plot 3

Date/Time: 26.01.2023 15.54.44

Test Laboratory: Verkotan Oy

DUT: HP500C-1

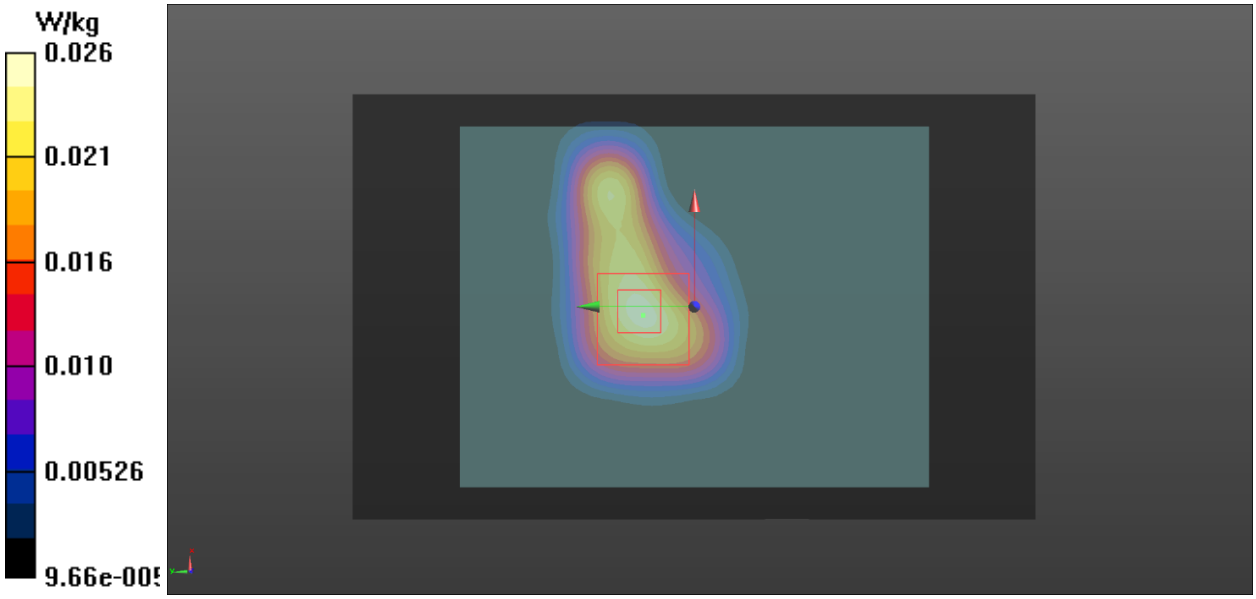
Communication System: UID 0, DECT (0); Communication System Band: USA; Frequency: 1924.99 MHz;
Communication System PAR: 10.79 dB;
Medium parameters used: f = 1925 MHz; σ = 1.334 S/m; ε_r = 39.948; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.72, 7.72, 7.72) @ 1924.99 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/Husqvarna headset, Left ear outside, DECT, CH2/Area Scan (51x81x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 0.0253 W/kg

Configuration/Husqvarna headset, Left ear outside, DECT, CH2/Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=7.5mm
Reference Value = 3.042 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.0640 W/kg
SAR(1 g) = 0.034 W/kg; SAR(10 g) = 0.00974 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.0259 W/kg



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Plot 4

Date/Time: 27.01.2023 10.45.40

Test Laboratory: Verkotan Oy

DUT: HP500C-1

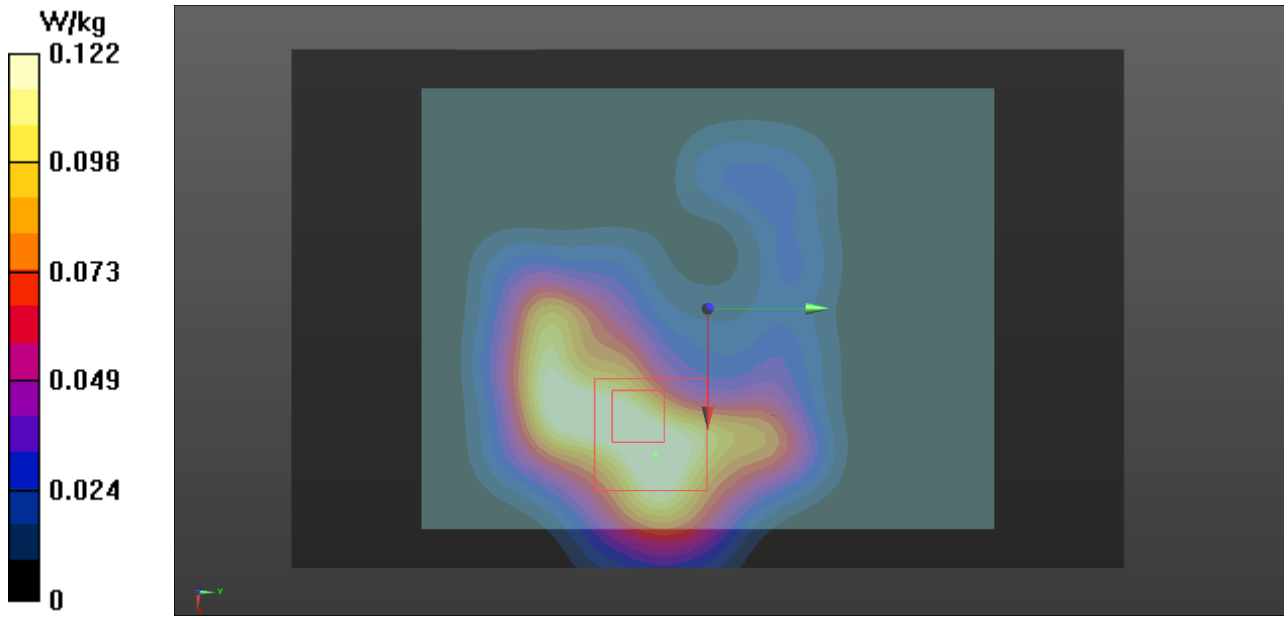
Communication System: UID 0, Bluetooth (0); Communication System Band: Bluetooth; Frequency: 2441 MHz;
Communication System PAR: 4.771 dB;
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.64 S/m; ε_r = 39.158; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.48, 7.48, 7.48) @ 2441 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration 2/Husqvarna headset, Left ear outside, bluetooth CH39 BR/EDR/Area Scan (51x81x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 0.136 W/kg

Configuration 2/Husqvarna headset, Left ear outside, bluetooth CH39 BR/EDR/Zoom Scan (7x7x5)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=7.5mm
Reference Value = 1.216 V/m; Power Drift = -0.76 dB
Peak SAR (extrapolated) = 0.184 W/kg
SAR(1 g) = 0.090 W/kg; SAR(10 g) = 0.048 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.122 W/kg



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Plot 5

Date/Time: 27.01.2023 12.21.59

Test Laboratory: Verkotan Oy

DUT: HP500BT-1

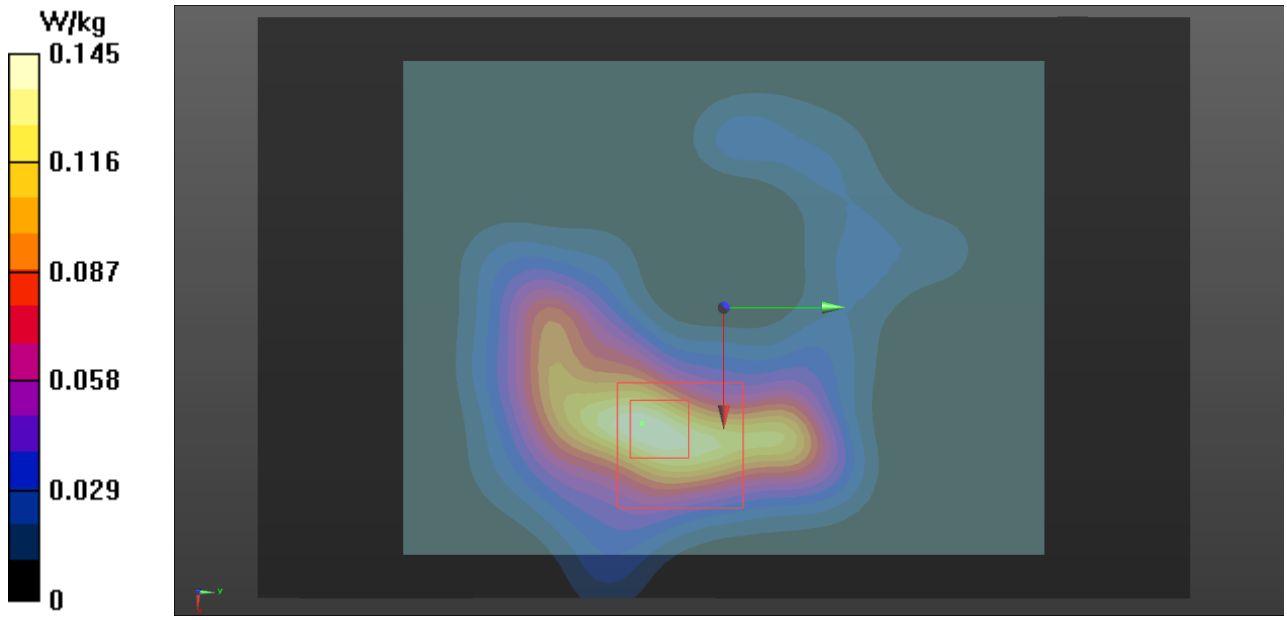
Communication System: UID 0, Bluetooth (0); Communication System Band: Bluetooth; Frequency: 2441 MHz;
Communication System PAR: 4.771 dB;
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.64 S/m; ε_r = 39.158; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.48, 7.48, 7.48) @ 2441 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/Husqvarna headset, Left ear outside, bluetooth CH39 BR/EDR/Zoom Scan (7x7x5)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=7.5mm
Reference Value = 1.575 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.327 W/kg
SAR(1 g) = 0.072 W/kg; SAR(10 g) = 0.038 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.104 W/kg

Configuration/Husqvarna headset, Left ear outside, bluetooth CH39 BR/EDR/Area Scan (51x81x1): Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 0.145 W/kg



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APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S 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: EX-3852_Oct22

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3852
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	October 27, 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
OCP DAK-3.5 (weighted)	SN: 1249	20-Oct-22 (OCP-DAK3.5-1249_Oct22)	Oct-23
OCP DAK-12	SN: 1016	20-Oct-22 (OCP-DAK12-1016_Oct22)	Oct-23
Reference 20 dB Attenuator	SN: CC2552 (20x)	04-Apr-22 (No. 217-03527)	Apr-23
DAE4	SN: 660	10-Oct-22 (No. DAE4-660_Oct22)	Oct-23
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-22)	In house check: Jun-24
Power sensor E4412A	SN: MY41496087	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-22)	In house check: Jun-24
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by	Michael Weber	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: October 27, 2022

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Certificate No: EX-3852_Oct22 Page 1 of 9

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Parameters of Probe: EX3DV4 - SN:3852

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc ($k = 2$)
Norm ($\mu V/(V/m)^2$) [A]	0.41	0.39	0.46	±10.1%
DCP (mV) [B]	99.8	98.2	99.9	±4.7%

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B $dB\sqrt{\mu V}$	C	D dB	VR mV	Max dev.	Max Unc[E] $k = 2$
0	CW	X	0.00	0.00	1.00	0.00	147.5	±2.5%	±4.7%
		Y	0.00	0.00	1.00		138.0		
		Z	0.00	0.00	1.00		137.1		

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 E^2-field uncertainty inside TSL (see Page 5).
[B] Linearization parameter uncertainty for maximum specified field strength.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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Parameters of Probe: EX3DV4 - SN:3852

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	126.7°
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.

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Parameters of Probe: EX3DV4 - SN:3852

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz)[C]	Relative Permittivity[F]	Conductivity[F] (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unc ($k = 2$)
6	55.0	0.75	15.18	15.18	15.18	0.00	1.00	±13.3%
30	55.0	0.75	13.34	13.34	13.34	0.00	1.00	±13.3%
64	54.2	0.75	11.88	11.88	11.88	0.00	1.00	±13.3%
128	52.8	0.76	11.57	11.57	11.57	0.00	1.00	±13.3%
220	49.0	0.81	10.92	10.92	10.92	0.00	1.00	±13.3%
450	43.5	0.87	10.20	10.20	10.20	0.16	1.30	±13.3%
900	41.5	0.97	8.82	8.82	8.82	0.44	0.94	±12.0%
1300	40.8	1.14	8.54	8.54	8.54	0.27	1.22	±12.0%
1450	40.5	1.20	8.63	8.63	8.63	0.39	0.80	±12.0%
1640	40.2	1.31	8.33	8.33	8.33	0.34	0.90	±12.0%
1810	40.0	1.40	7.90	7.90	7.90	0.38	0.90	±12.0%
1900	40.0	1.40	7.72	7.72	7.72	0.36	0.90	±12.0%
2450	39.2	1.80	7.48	7.48	7.48	0.41	0.90	±12.0%
3300	38.2	2.71	6.85	6.85	6.85	0.30	1.30	±13.1%
3500	37.9	2.91	6.83	6.83	6.83	0.30	1.35	±13.1%
3700	37.7	3.12	6.65	6.65	6.65	0.30	1.35	±13.1%
3900	37.5	3.32	6.38	6.38	6.38	0.40	1.60	±13.1%
4100	37.2	3.53	6.19	6.19	6.19	0.40	1.60	±13.1%
5250	35.9	4.71	4.90	4.90	4.90	0.40	1.80	±13.1%
5600	35.5	5.07	4.61	4.61	4.61	0.40	1.80	±13.1%
5750	35.4	5.22	4.65	4.65	4.65	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.

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APPENDIX E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS

SAR Reference Dipole Calibration Report

Ref : ACR.84.5.20.MVGB.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
SAR REFERENCE DIPOLE
FREQUENCY: 1900 MHZ
SERIAL NO.: SN 511

Calibrated at MVG
Z.I. de la pointe du diable
Technopôle Brest Iroise – 295 avenue Alexis de Rochon
29280 PLOUZANE - FRANCE

Calibration date: 03/23/2020

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed at MVG, using the COMOSAR test bench. The test results covered by accreditation are traceable to the International System of Units (SI).

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3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 MEASUREMENT CONDITION

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 38.5 sigma : 1.45
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-80 %

7.2 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±10 %		0.87 ±10 %	
450	43.5 ±10 %		0.87 ±10 %	
750	41.9 ±10 %		0.89 ±10 %	
835	41.5 ±10 %		0.90 ±10 %	
900	41.5 ±10 %		0.97 ±10 %	
1450	40.5 ±10 %		1.20 ±10 %	
1500	40.4 ±10 %		1.23 ±10 %	
1640	40.2 ±10 %		1.31 ±10 %	
1750	40.1 ±10 %		1.37 ±10 %	
1800	40.0 ±10 %		1.40 ±10 %	
1900	40.0 ±10 %	38.5	1.40 ±10 %	1.45
1950	40.0 ±10 %		1.40 ±10 %	
2000	40.0 ±10 %		1.40 ±10 %	
2100	39.8 ±10 %		1.49 ±10 %	

Page: 7/10

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2300	39.5 ±10 %		1.67 ±10 %	
2450	39.2 ±10 %		1.80 ±10 %	
2600	39.0 ±10 %		1.96 ±10 %	
3000	38.5 ±10 %		2.40 ±10 %	
3500	37.9 ±10 %		2.91 ±10 %	

7.3 MEASUREMENT RESULT

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7	37.10 (3.71)	20.5	19.14 (1.91)
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S 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

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Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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)**

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