SAR Compliance Test Report

Date of Report	8/10/2018	**Client's Contact person:**	Matti Mäkiniemi
Number of pages:	27	**Responsible Test engineer:**	Kirsi Kyllönen
Testing laboratory:	**Verkotan Oy** Elektroniikkatie 17 90590 Oulu Finland	**Client:**	**Oura Health Ltd** Elektroniikkatie 10 90590 Oulu Finland
Tested device	Wellness Ring		
Related reports:	-		

Testing has been carried out in accordance with:

Council Recommendation 1999/519/EC of 12 July 1999
on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

EN 50566 (2017)
Product standard to demonstrate the compliance of wireless communication devices with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields in the frequency range from 30 MHz to 6 GHz: hand-held and body mounted devices in close proximity to the human body

IEC 62209-2 (2010), EN 62209-2 (2010)
Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)

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:

08.10.2018

Miia Nurkkala

Digitaalinen allekirjoittaja: Miia Nurkkala
Päiväys: 2018.10.08 12:43:47 +03'00'

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (EUT):

Product:	Wellness Ring
Manufacturer:	Oura Health Oy
Model:	OURA
DUT Number:	Ring sizes: 6, 8, 9, 10, 12
Serial Number:	6: A038F8B04DBD, 8: A038F89E5D9D, 9: A038F89E5829, 10: A038F8B04D14, 12: A038F89E6819
Battery Type used in testing:	Integrated battery
State of the Sample	Production sample

Testing information:

Testing performed:	24-26.9.2018
Document ID:	SAR Report_Oura Ring_ID2821b_05102018.docx
Temperature °C	22±2 / Controlled
Humidity RH%	30±20 / Controlled
Measurement performed by:	Kirsi Kyllönen

1.2 Maximum Results

The maximum measured SAR value for body-worn condition. 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_{10g} limit for general population/uncontrolled exposure is 2.0 W/Kg for head and body specified by council recommendation 1999/519/EC Annex II.

System	Highest SAR_{10g}(W/kg) in Body-Worn Condition 0 mm separation distance	Limit (W/kg)	Result
Bluetooth Low Energy	**0.0003**	**2**	**PASS**

The maximum measured SAR results is 0.15 thousandths of the maximum allowed SAR value.

1.2.1 Measurement Uncertainty

Expanded Uncertainty (k=2) 95 %	**±24.9 %**

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2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

Device under testing is a ring that sensors sleep and activity. Device is worn in the finger of the user.

Exposure Environment	General population, uncontrolled

2.1 Supported Frequency Bands and Operational Modes

TX Frequency bands	Modes of Operation	Transmitter Frequency Range (MHz)
	Bluetooth Low Energy	2402-2480

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3. 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.

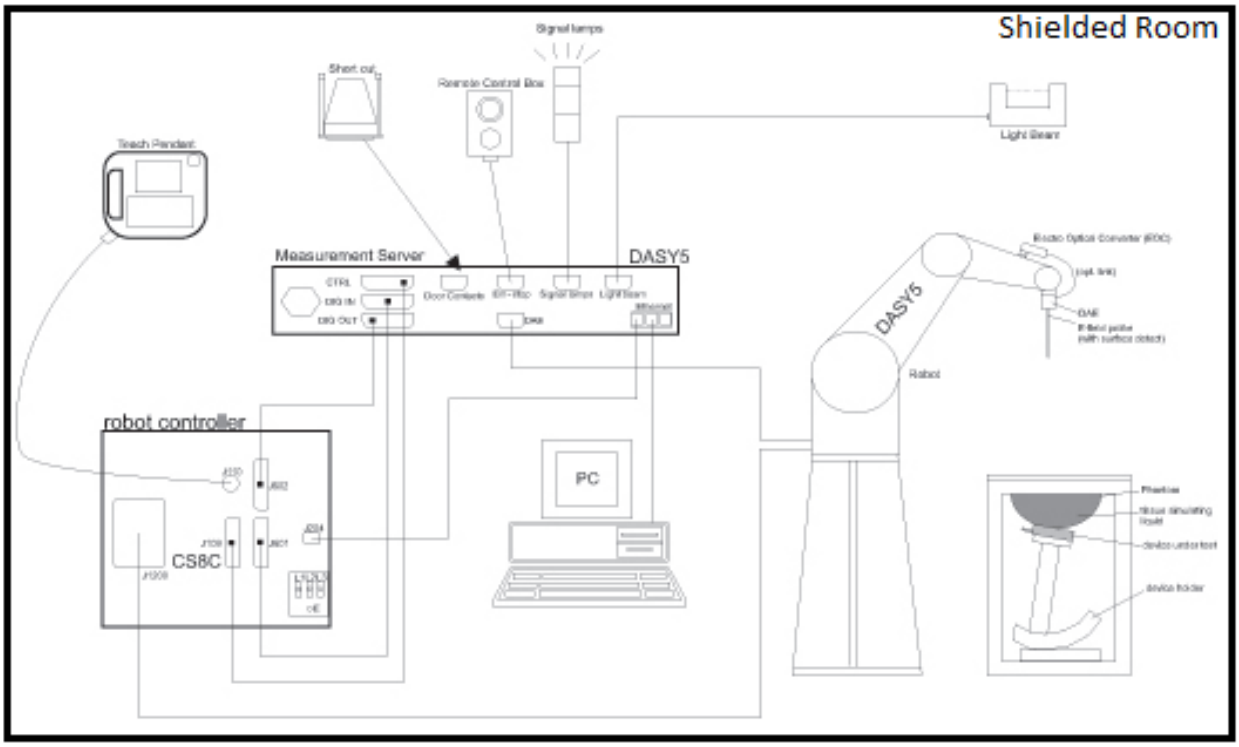

Figure 1 Schematic Laboratory Picture

3.1 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
DAE	DAE4	756	03.2018
Probe	EX3DV4	3892	03.2018
Dipole	D2450V2	729	07.2017
DASY5 Software	52.8.8.1258	-	NA
Signal Generator	Agilent E4438C	MY42082627	NA
Amplifier	AR 60S1G3M3	301908	NA
Power Meter / Sensor	NRP-Z81	101128	07.2018

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3.1.1 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

3.2 Phantom

Modular Flat Phantom (MFP)

The Triple Modular Phantom consists of three identical modules that can be installed and removed separately without emptying the liquid. It is used for compliance testing of small wireless devices in body-worn configurations.

3.3 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given IEC62209-1. The dielectric parameters of the used tissue simulants were within ±10% of the recommended values in all frequencies used. A compensation algorithm was used to correct for the deviations in liquid parameters. SAR testing was carried out within 24 hours of measuring the dielectric parameters. Depth of the tissue simulant was at least 15.0 cm from the inner surface of the flat phantom.

Ingredient	Head (% by weight) 2350-2700*
Deionized Water	50-65
Emulsion	8-25
Salt	0-1.5
Oil	8.5-42

* Recipe is proprietary to SPEAG. The proportions of the constituents have not been disclosed

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3.4 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
							Head tissue simulant
2450	D2450V2 / 729	EX3DV4 / 3892	CW	DAE4 / 705	41.38	1.86	4/2018

3.5 System Check

Date	Tissue Type	Tissue Temp. [°C]	Frequency [MHz]	Input Power	Measured SAR_{1g} [W/kg]	1 W Target SAR_{1g} [W/kg]	1 W Normalized SAR_{1g} [W/kg]	Deviation (%)	Plot #
24.09.2018	H2450	20.9	2450	250mW	12.8	53.4	51.2	-4.2	1
26.09.2018	H2450	21.3	2450	250mW	12.8	53.4	51.2	-4.2	2

3.5.1 Tissue Simulant Verification

				Target		Measured		Deviation	
Date	Tissue Type	Tissue Temp. [°C]	Frequency [MHz]	Dielectric Constant [ε]	Conductivity, σ [S/m]	Dielectric Constant [ε]	Conductivity, σ [S/m]	ε (%)	σ (%)
24.9.2018	**H2450**	22	2440	**39.2**	**1.79**	41.9	1.88	6.8	5.1
24.9.2018	**H2450**	22	2450	**39.2**	**1.8**	41.9	1.89	6.8	5.0
26.9.2018	**H2450**	22	2440	**39.2**	**1.79**	41.8	1.89	6.6	5.7
26.9.2018	**H2450**	22	2450	**39.2**	**1.8**	41.8	1.9	6.6	5.6

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4. TEST PROCEDURE

The DUT was set to transmit at a maximum power available by using manufacturer specified software. Mid channel was used for the testing.

Testing was performed in three different operating conditions of the DUT;

1) Bluetooth low energy transmitter active

2) Bluetooth low energy transmitter inactive, IR off

3) Airplane mode: IR on, Bluetooth low energy transmitter inactive

4.1 Device Holder

The device was placed in the device holder that is supplied by SPEAG.

4.2 Test Positions

4.2.1 Body-Worn Configuration, 0 mm separation

The DUT was placed below the flat phantom using a SPEAG device holder. The DUT was lifted towards the phantom until 0mm separation distance was reached. Testing was done on three sides; the top side (Oura text right way inside the device), bottom side, which is 180° to top side and on the side of the outer ring. Photos of the test positions are presented in appendix A.

4.3 Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan, a minimum of 5x5x7 points covering a volume of at least 30x30x30mm, 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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4.4 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.

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5. MEASUREMENT UNCERTAINTY

Uncertainty Budget
According to IEC 62209-2/2010
(30 MHz - 6 GHz range)

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.55 %	N	1	1	1	±6.55 %	±6.55 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
Modulation Response^m	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Boundary Effects	±2.0 %	R	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Probe Positioning	±6.7 %	R	$\sqrt{3}$	1	1	±3.9 %	±3.9 %	∞
Post-processing	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Test Sample Related								
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Test sample Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Power Scaling^p	±0 %	R	$\sqrt{3}$	1	1	±0.0 %	±0.0 %	∞
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Setup								
Phantom Uncertainty	±7.6 %	R	$\sqrt{3}$	1	1	±4.4 %	±4.4 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.) ^{DAK}	±2.5 %	R	$\sqrt{3}$	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity ^{BB}	±3.4 %	R	$\sqrt{3}$	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity ^{BB}	±0.4 %	R	$\sqrt{3}$	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±12.5 %	±12.4 %	748
Expanded STD Uncertainty						**±24.9 %**	**±24.9 %**	

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6. TEST RESULTS

6.1 SAR Results for 0 mm separation

Bluetooth low energy transmitter active:

Band	Frequency [MHz]	Ring Size	Test Position	Dudy Cycle	Power used in measurements (dBm)	Field Power (dBm)	Scaling factor	Measured SAR_{10g} [mW/g]	Measured SAR_{10g} [mW/g]	Plot #
2.45	2440	6	Top	1:3	4	0	0.40	0.00029	0.000115	
2.45	2440	6	Bottom	1:3	4	0	0.40	0.00030	0.000119	
2.45	2440	6	Side	1:3	4	0	0.40	0.00020	0.000080	
2.45	2440	8	Top	1:3	4	0	0.40	0.00074	0.000295	3
2.45	2440	8	Bottom	1:3	4	0	0.40	0.00060	0.000239	4
2.45	2440	8	Side	1:3	4	0	0.40	0.00004	0.000016	5
2.45	2440	9	Top	1:3	4	0	0.40	0.00011	0.000044	
2.45	2440	9	Bottom	1:3	4	0	0.40	0.00016	0.000064	
2.45	2440	9	Side	1:3	4	0	0.40	0.00001	0.000004	
2.45	2440	10	Top	1:3	4	0	0.40	0.00011	0.000044	
2.45	2440	10	Bottom	1:3	4	0	0.40	0.00001	0.000004	
2.45	2440	10	Side	1:3	4	0	0.40	0.00005	0.000020	
2.45	2440	12	Top	1:3	4	0	0.40	0.00001	0.000004	
2.45	2440	12	Bottom	1:3	4	0	0.40	0.00002	0.000008	
2.45	2440	12	Side	1:3	4	0	0.40	0.00006	0.000024	

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

Bluetooth low energy transmitter inactive, IR off:

Band	Frequency [MHz]	Ring Size	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
2.45	2440	8	Top	--	0.000009	6

Airplane mode: IR on, Bluetooth low energy transmitter inactive

Band	Frequency [MHz]	Ring Size	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
2.45	2440	9	Top	--	0.00002	

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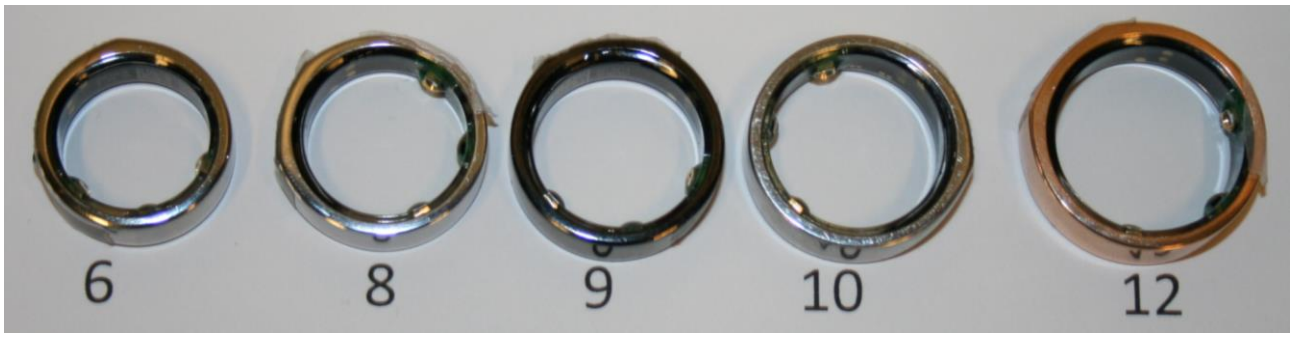
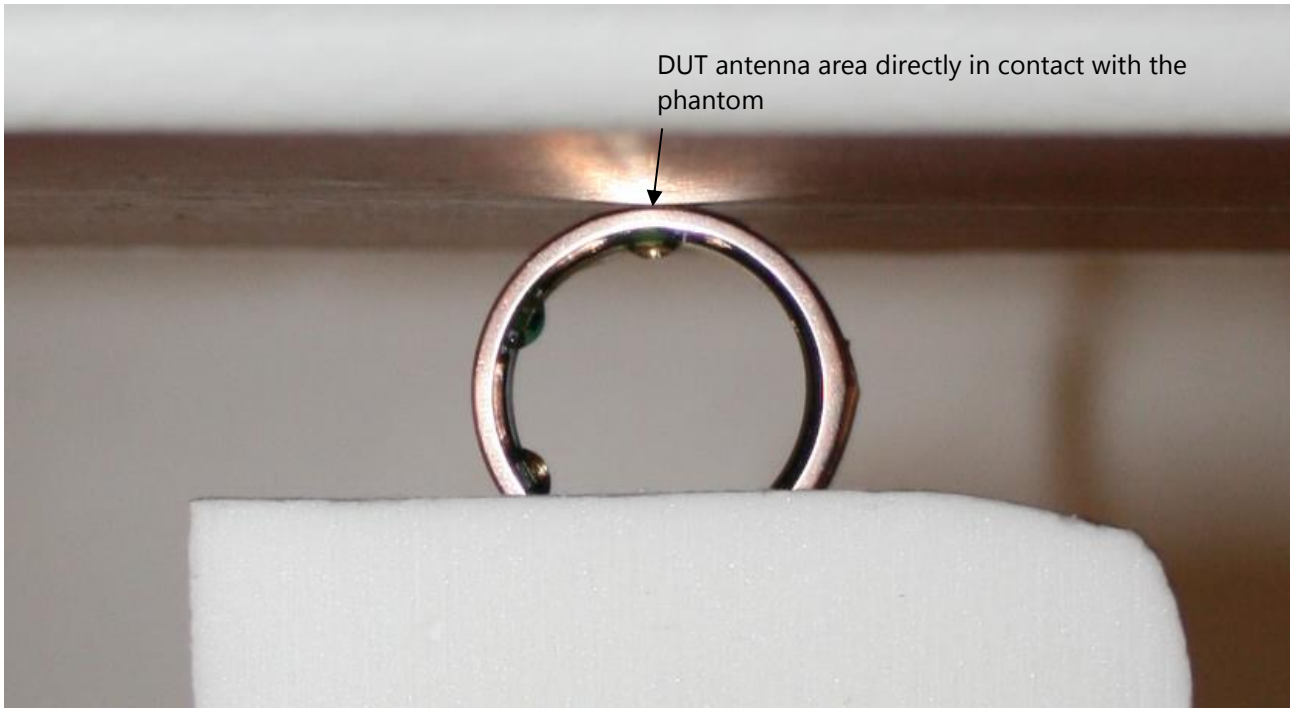
APPENDIX A: PHOTOS OF THE DUT

Devices under testing were 5 rings of different size, from size 6 to 12.





Side of the DUT against the phantom.

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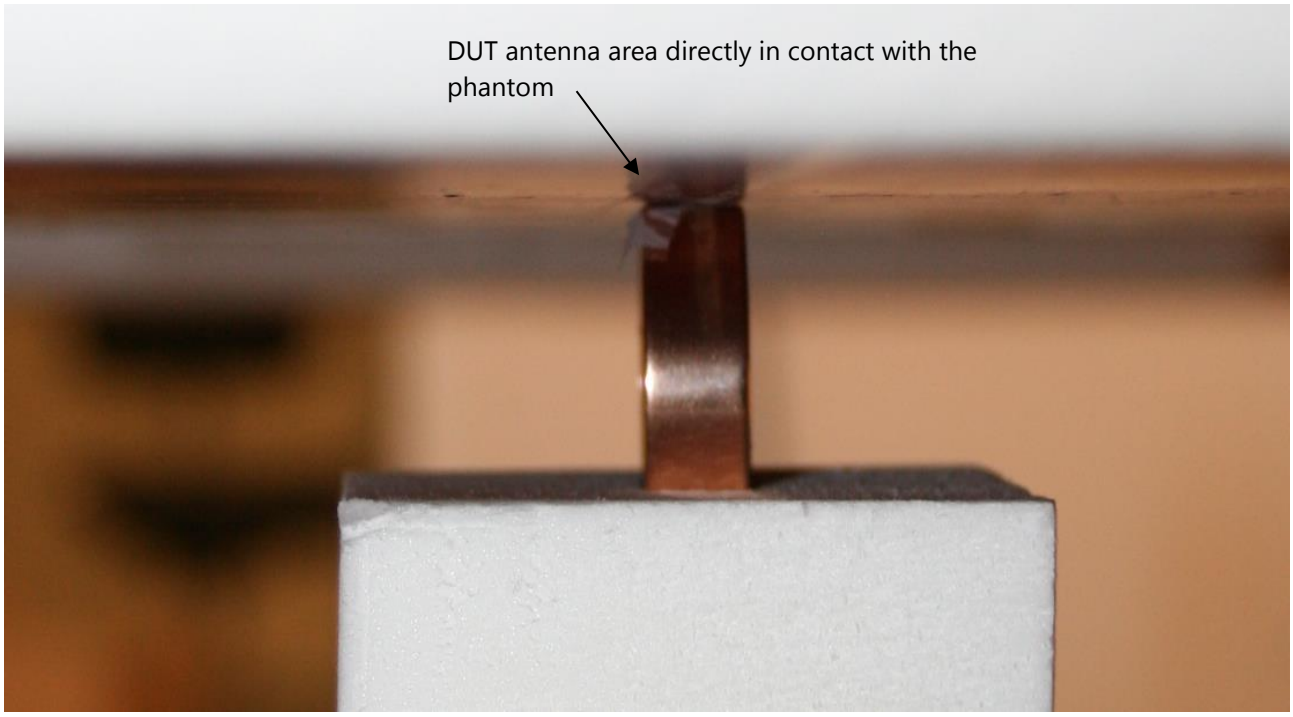
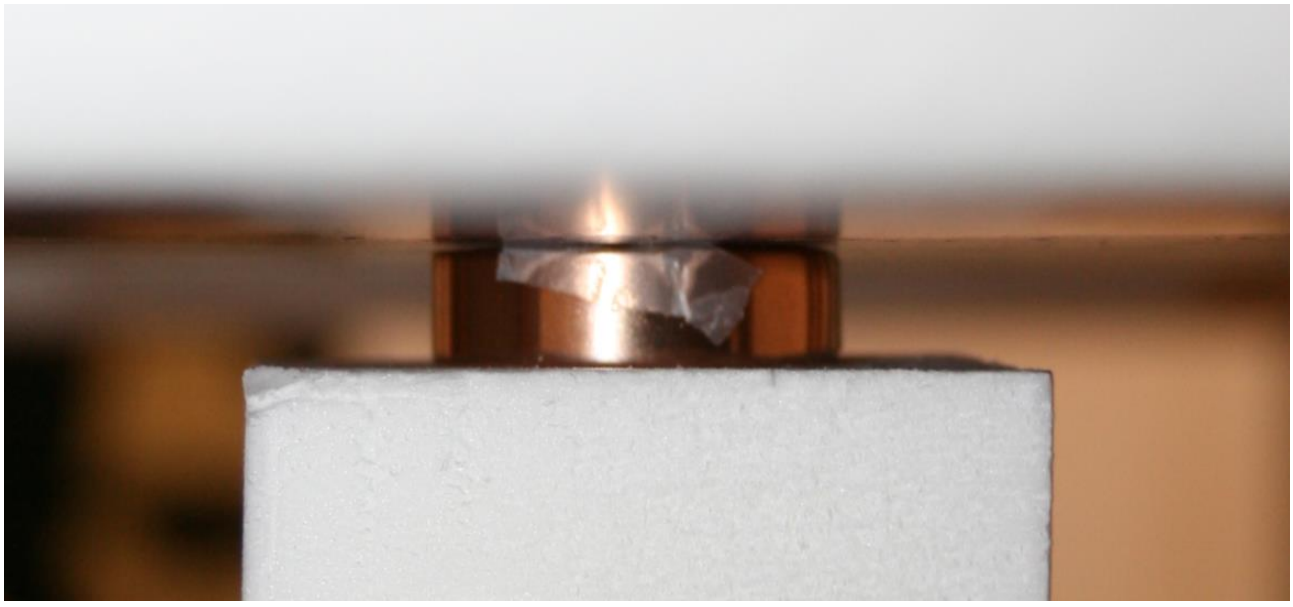


Side of the DUT against the phantom.



Bottom of the DUT against the phantom. For the top position the DUT is rotated 180°, the position is similar to bottom position.

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APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 24.9.2018 14:57:50

Test Laboratory: Verkotan Oy

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

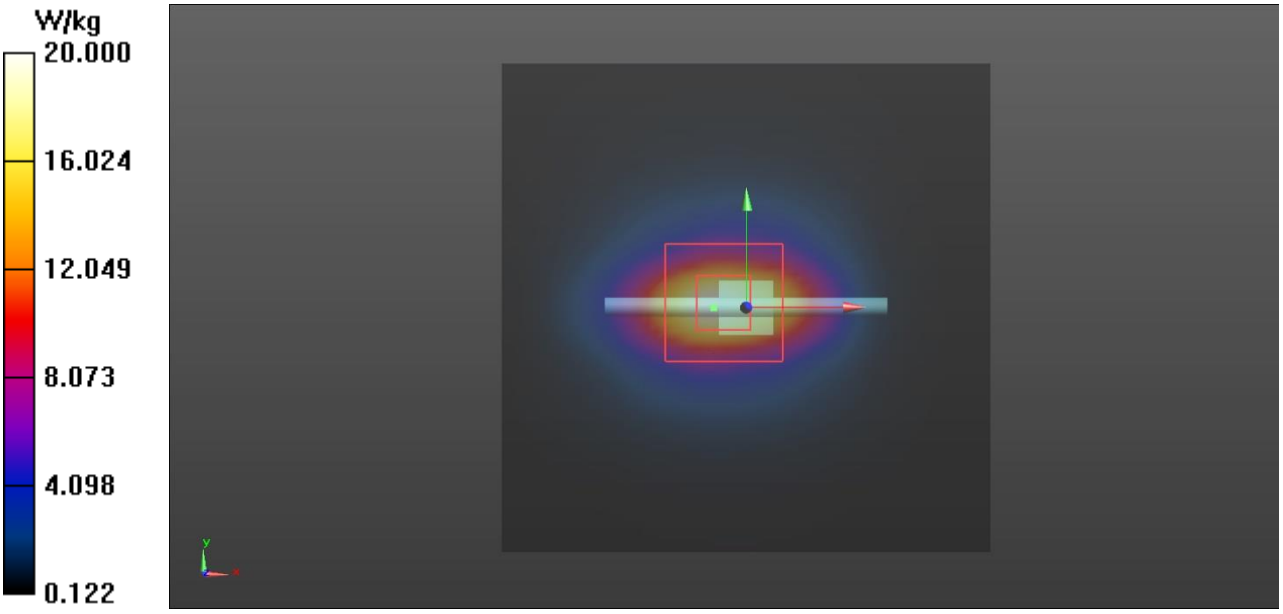
Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 2450 MHz; σ = 1.891 S/m; ε_r = 41.866; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.46, 7.46, 7.46); Calibrated: 20.4.2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 31.0
- Electronics: DAE4 Sn756; Calibrated: 8.3.2018
- Phantom: SAR2_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 03_May_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration Pin=250 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.4 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 27.3 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.96 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.0 W/kg

Configuration Pin=250 mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 21.6 W/kg



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Plot 2

Date/Time: 26.9.2018 9:49:33

Test Laboratory: Verkotan Oy

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

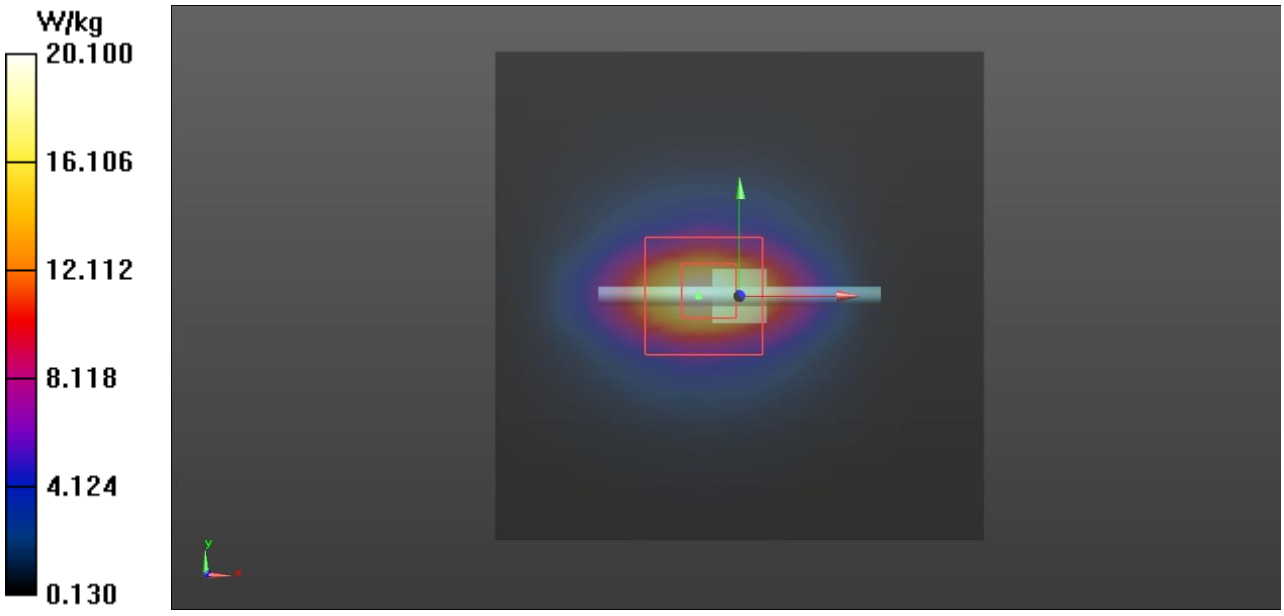
Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 2450 MHz; σ = 1.901 S/m; ε_r = 41.776; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.46, 7.46, 7.46); Calibrated: 20.4.2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 31.0
- Electronics: DAE4 Sn756; Calibrated: 8.3.2018
- Phantom: SAR2_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 03_May_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration Pin=250 mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.4 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 27.7 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.94 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.1 W/kg

Configuration Pin=250 mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 22.3 W/kg



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APPENDIX C: MEASUREMENT SCANS

Plot 3

Date/Time: 25.9.2018 14:14:44

Test Laboratory: Verkotan Oy

DUT: Oura Ring; Type: Size 8, Top

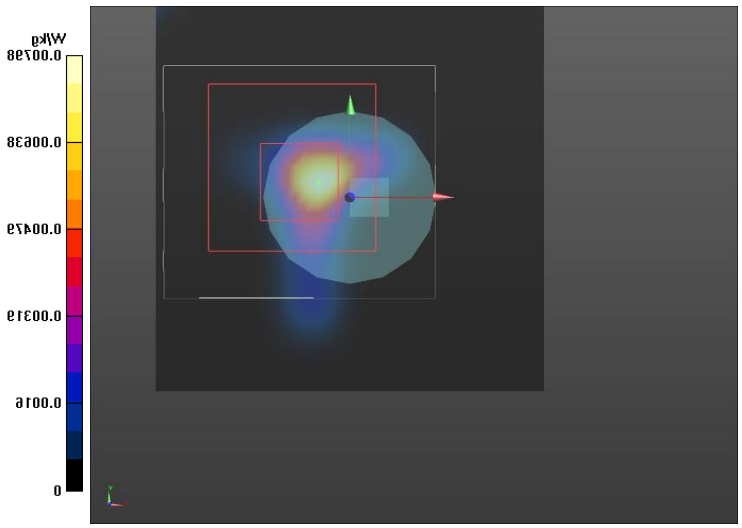
Communication System: UID 0, Bluetooth (0); Communication System Band: Oura; Frequency: 2440 MHz;Communication System PAR: 4.771 dB; PMF: 1
Medium parameters used: f = 2440 MHz; σ = 1.882 S/m; ε_r = 41.886; ρ = 1000 kg/m^3
Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.46, 7.46, 7.46); Calibrated: 20.4.2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
- Electronics: DAE4 Sn756; Calibrated: 8.3.2018
- Phantom: SAR2_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 03_May_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Size 8_top /Zoom Scan 2 (8x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.331 V/m; Power Drift = 1.52 dB Peak SAR (extrapolated) = 0.0110 W/kg
SAR(1 g) = 0.00398 W/kg; SAR(10 g) = 0.000742 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00601 W/kg

Configuration/Size 8_top 2/Area Scan (51x51x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.00798 W/kg



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Plot 4

Date/Time: 25.9.2018 14:36:19

Test Laboratory: Verkotan Oy

DUT: Oura Ring; Type: Size 8, Bottom

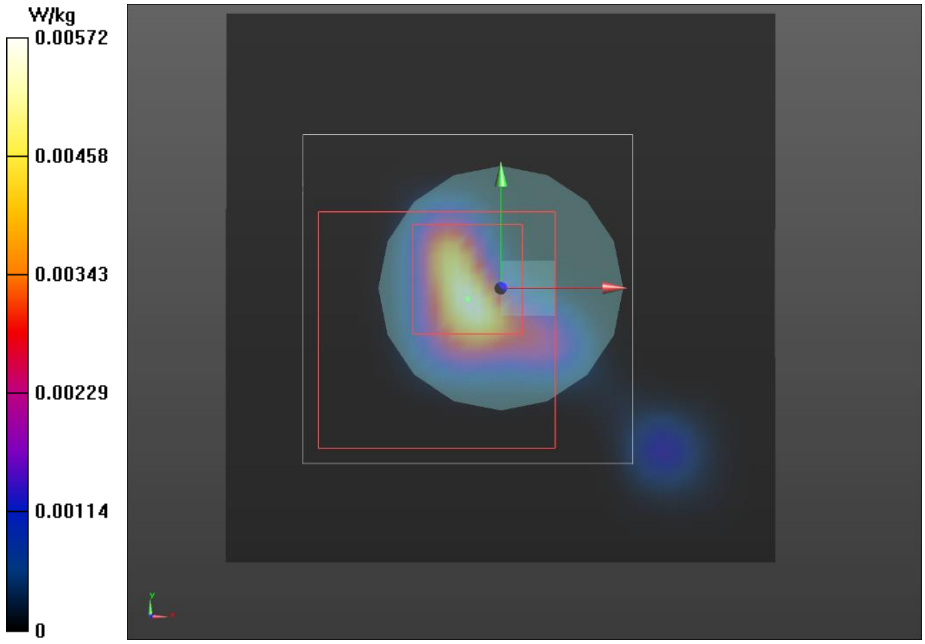
Communication System: UID 0, Bluetooth (0); Communication System Band: Oura; Frequency: 2440 MHz;Communication System PAR: 4.771 dB; PMF: 1
Medium parameters used: f = 2440 MHz; σ = 1.882 S/m; ε_r = 41.886; ρ = 1000 kg/m^3
Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.46, 7.46, 7.46); Calibrated: 20.4.2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection), z = -4.0, 31.0
- Electronics: DAE4 Sn756; Calibrated: 8.3.2018
- Phantom: SAR2_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 03_May_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Size 8_bottom/Area Scan (51x51x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.00572 W/kg

Configuration/Size 8_bottom/Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.382 V/m; Power Drift = 1.80 dB Peak SAR (extrapolated) = 0.0140 W/kg
SAR(1 g) = 0.00336 W/kg; SAR(10 g) = 0.000599 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00456 W/kg



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Plot 5

Date/Time: 25.9.2018 13:50:12

Test Laboratory: Verkotan Oy

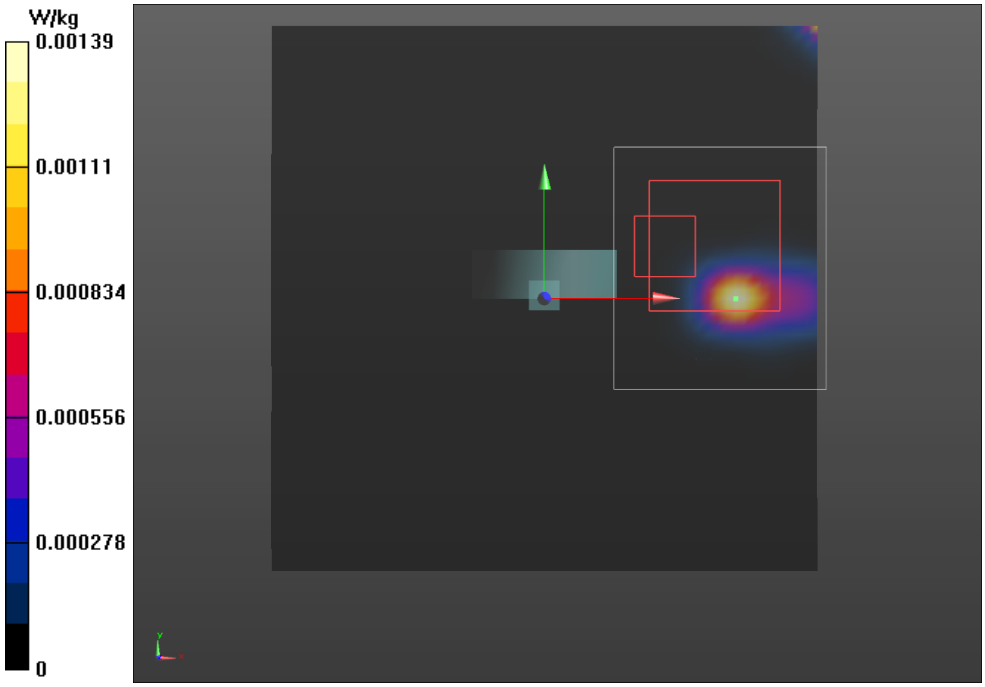
DUT: Oura Ring; Type: Size 8, Side

Communication System: UID 0, Bluetooth (0); Communication System Band: Oura; Frequency: 2440 MHz;Communication System PAR: 4.771 dB; PMF: 1
Medium parameters used: f = 2440 MHz; σ = 1.882 S/m; ε_r = 41.886; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.46, 7.46, 7.46); Calibrated: 20.4.2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
- Electronics: DAE4 Sn756; Calibrated: 8.3.2018
- Phantom: SAR2_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 03_May_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration 2/Size 8_side antenna 2/Zoom Scan 2 (8x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.1940 V/m; Power Drift = 10.74 dB Peak SAR (extrapolated) = 0.00311 W/kg
SAR(1 g) = 0.000146 W/kg; SAR(10 g) = 3.78e-005 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00311 W/kg
Configuration 2/Size 8_side antenna 2/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.00139 W/kg



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Plot 6

Date/Time: 26.9.2018 12:23:24

Test Laboratory: Verkotan Oy

DUT: Oura Ring; Type: Size 8, Top

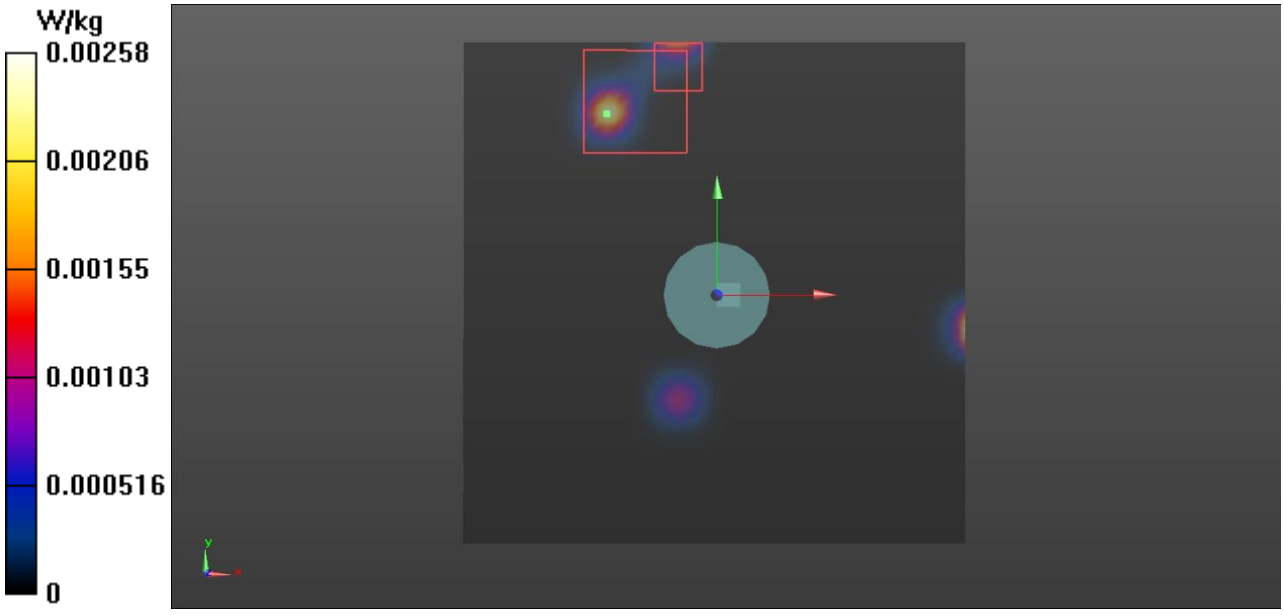
Communication System: UID 0, Bluetooth (0); Communication System Band: Oura; Frequency: 2440 MHz;Communication System PAR: 4.771 dB; PMF: 1
Medium parameters used: f = 2440 MHz; σ = 1.893 S/m; ε_r = 41.789; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.46, 7.46, 7.46); Calibrated: 20.4.2018;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn756; Calibrated: 8.3.2018
- Phantom: SAR2_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 03_May_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration 7/Size 8_side top, no transmission/Zoom Scan 2 (9x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.3510 V/m; Power Drift = 6.62 dB
Peak SAR (extrapolated) = 0.00250 W/kg
SAR(1 g) = 3.21e-005 W/kg; SAR(10 g) = 9.25e-006 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00258 W/kg

Configuration 7/Size 8_side top, no transmission/Area Scan (71x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.00269 W/kg



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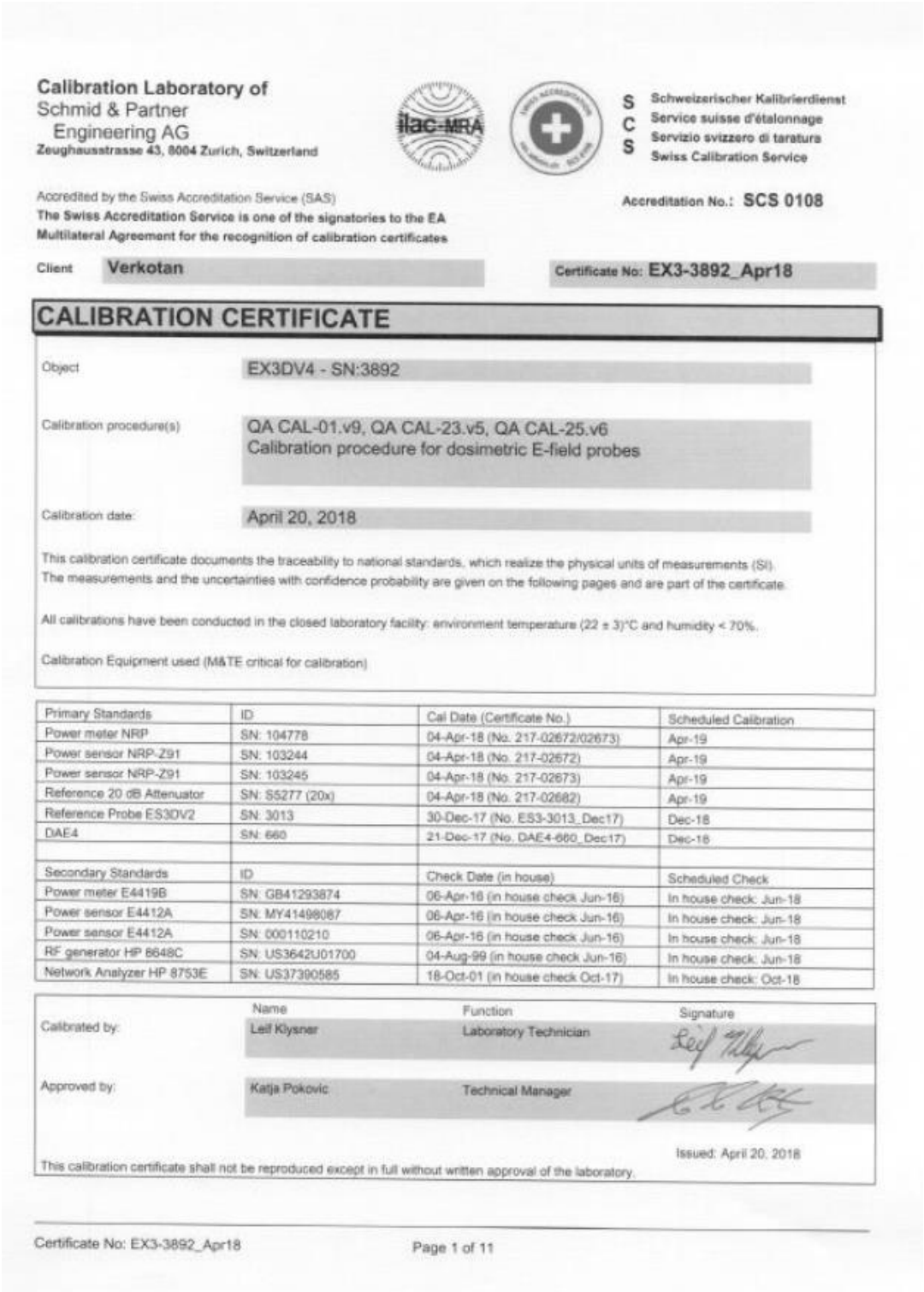
APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS



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
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: EX3-3892_Apr18

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3892

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

Calibration date: April 20, 2018

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-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 20, 2018

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

Certificate No: EX3-3892_Apr18 Page 1 of 11

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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)
750	41.9	0.89	10.51	10.51	10.51	0.49	0.80	± 12.0 %
900	41.5	0.97	9.85	9.85	9.85	0.49	0.82	± 12.0 %
1750	40.1	1.37	8.59	8.59	8.59	0.35	0.80	± 12.0 %
1900	40.0	1.40	8.33	8.33	8.33	0.31	0.80	± 12.0 %
2450	39.2	1.80	7.46	7.46	7.46	0.30	0.85	± 12.0 %
2600	39.0	1.96	7.35	7.35	7.35	0.25	1.04	± 12.0 %

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

Calibration Parameter Determined in Body 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)
750	55.5	0.96	10.03	10.03	10.03	0.52	0.80	± 12.0 %
900	55.0	1.05	10.08	10.08	10.08	0.45	0.85	± 12.0 %
1750	53.4	1.49	8.21	8.21	8.21	0.38	0.85	± 12.0 %
1900	53.3	1.52	7.93	7.93	7.93	0.35	0.83	± 12.0 %
2450	52.7	1.95	7.52	7.52	7.52	0.33	0.93	± 12.0 %

[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. 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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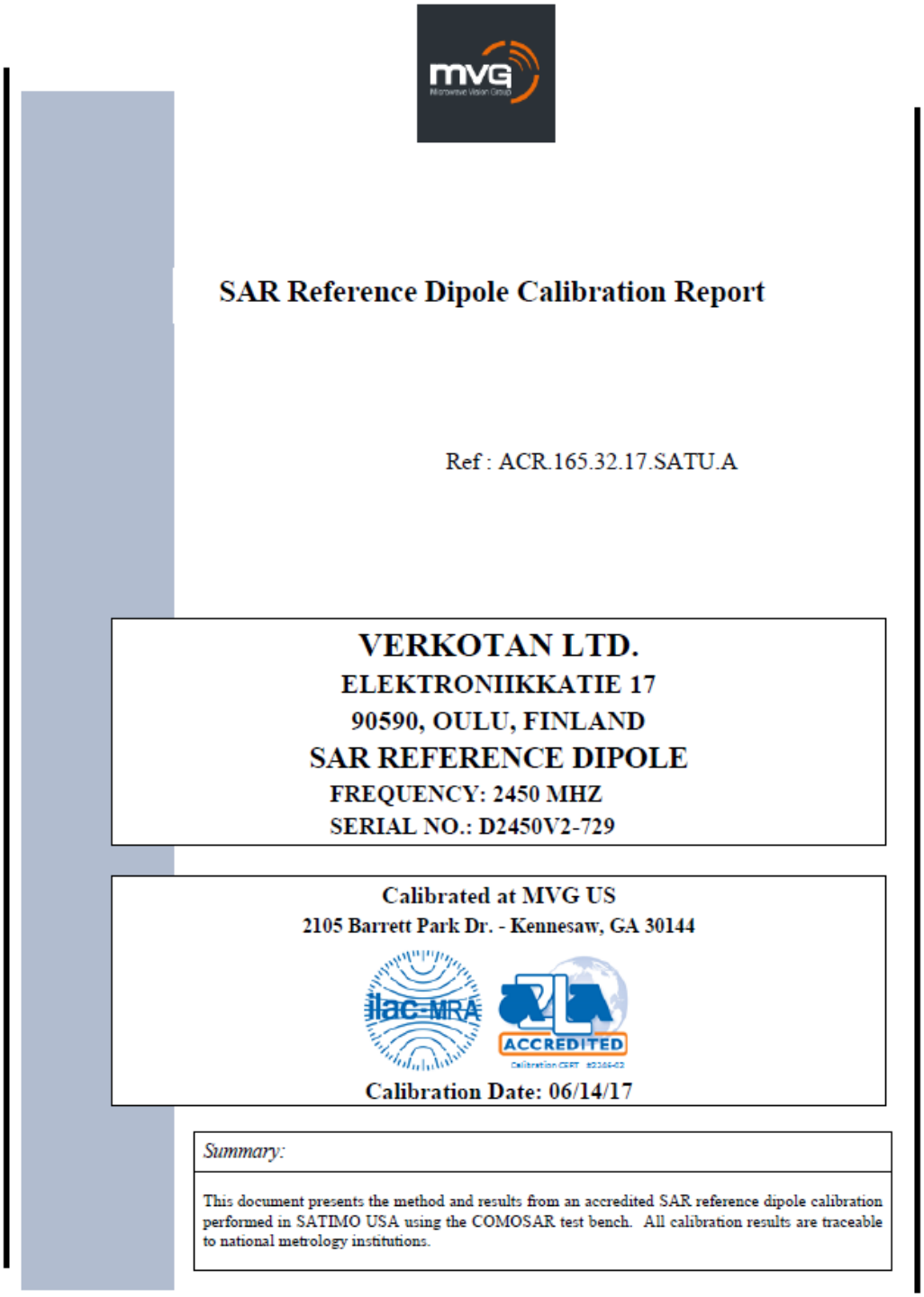
APPENDIX E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS



SAR Reference Dipole Calibration Report

Ref : ACR.165.32.17.SATU.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
SAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: D2450V2-729

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration Date: 06/14/17

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

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	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	6/14/2017	
Checked by :	Jérôme LUC	Product Manager	6/14/2017	
Approved by :	Kim RUTKOWSKI	Quality Manager	6/14/2017	

	Customer Name
Distribution :	Verkotan Ltd.

Issue	Date	Modifications
A	6/14/2017	Initial release

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1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 37.5 sigma : 1.80
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

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		20.5	
1950	40.5		20.9	

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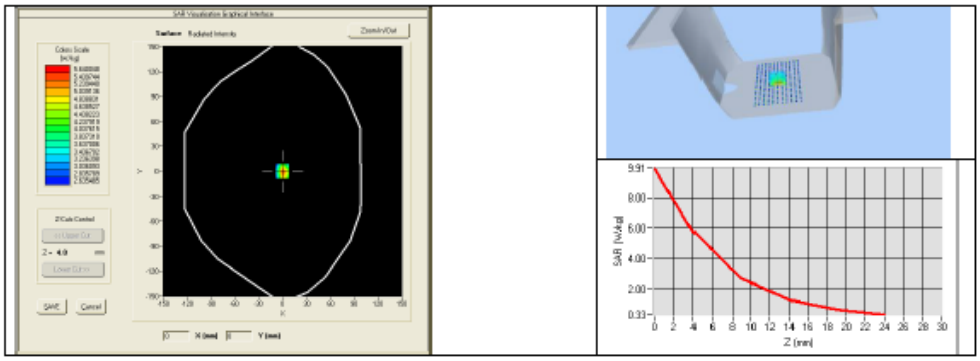
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	53.43 (5.34)	24	24.05 (2.41)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %	PASS	1.95 ±5 %	PASS
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	

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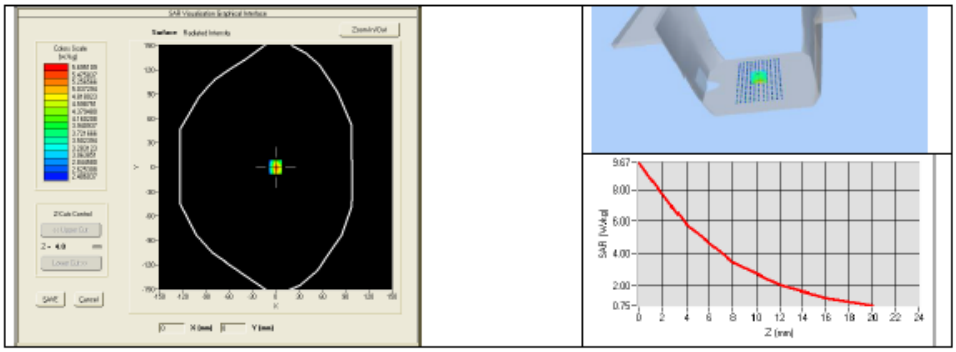
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 53.2 sigma : 1.89
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=5mm/dy=5mm/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	53.69 (5.37)	24.72 (2.47)



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