SAR Compliance Test Report

Date of Report	13/03/2020	**Client's Contact person:**	Nikoletta Juhasz
Number of pages:	32	**Responsible Test engineer:**	Kirsi Kyllönen
Testing laboratory:	**Verkotan Oy** Elektroniikkatie 17 90590 Oulu Finland	**Client:**	**Spaceharmony-system Ltd** Budapest Bem u. 6 1027 Budapest HUNGARY
Tested device	**Spaceharmony-system E-smog**		
Related reports:	-		
Testing has been carried out in accordance with:	**ICNIRP (1998)** Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and electromagnetic Fields (up to 300 GHz) **BS EN 62209-1 (2016)** 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 Part 1: Devices used next to the ear (Frequency range of 300 MHz to 6 GHz) **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 test results relate only to devices specified in this document		

Date and signatures:

13.03.2020

Miia Nurkkala

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Date: 2020.03.13 14:00:11 +02'00'

Laboratory Manager

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SUMMARY OF SAR TEST REPORT

1.1 Test Details

Device under Test (DUT):

Product:	Spaceharmony-system E-smog
Manufacturer:	Spaceharmony-system Ltd
Model:	E-smog
State of the Sample	Proto sample

Testing information:

Testing performed:	20-24.2.2020
Notes:	Phone Huawei P30 Pro was used for testing the products
Document ID:	SAR Report_ Spaceharmony_E-smog ID3913 11032020.docx
Temperature °C	22±2
Humidity RH%	30±20
Measurement performed by:	Kirsi Kyllönen

1.2 Results

The reported SAR values for head exposure condition and body-worn condition. The complete test results are in section 6.

1.2.1 Maximum Drift

Maximum Drift During Measurements	-0.56 dB

1.2.2 Measurement Uncertainty

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

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The tested devices were a shield, E-smog, manufactured by Spaceharmony-system Ltd. Phone Huawei P30 Pro was used for testing the products.

Exposure Environment	General population, uncontrolled

2.1 Tested Frequency Bands and Operational Modes

TX Frequency bands	Modes of Operation	Transmitter Frequency Range (MHz)
	LTE 3	1805-1880
	LTE 20	731-821

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.

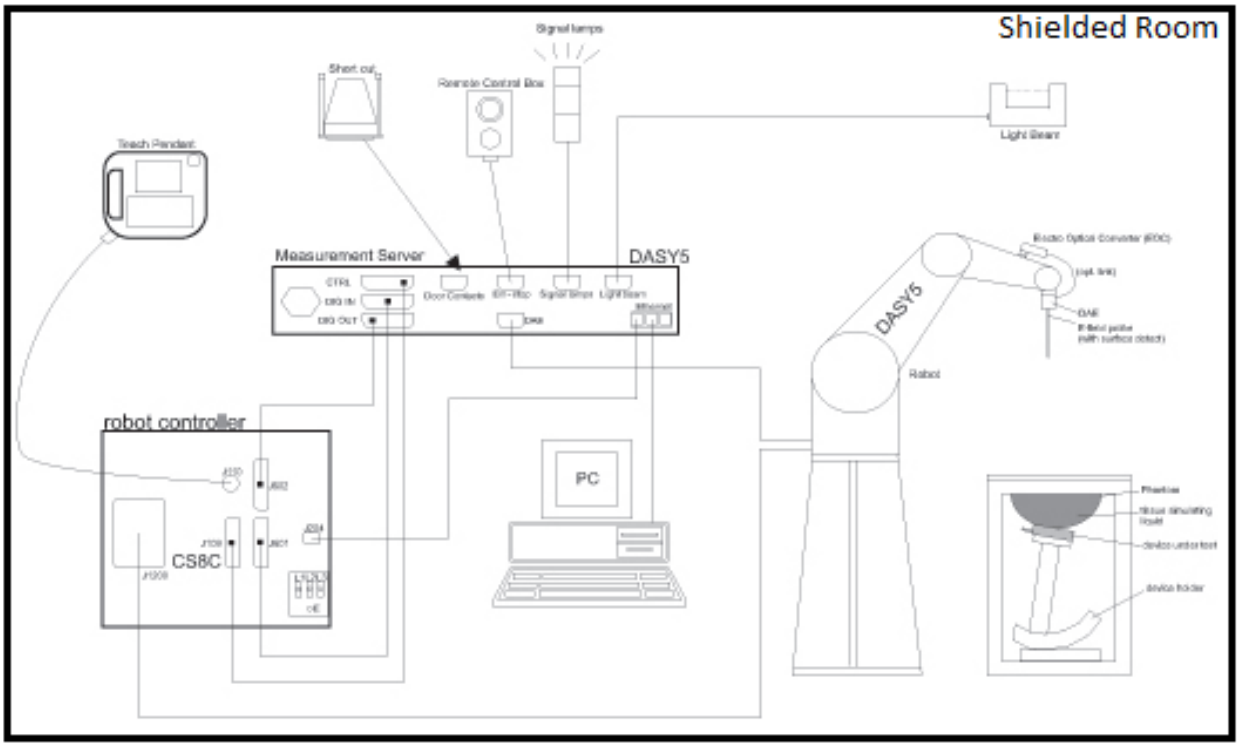


Figure 1 Schematic Laboratory Picture

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	1332	10.2019
Probe	EX3DV4	3892	04.2019
Dipole	D835V2	473	12.2018
Dipole	D1800V2	2D075	06.2017
DASY5 Software	52.8.8.1258	-	NA
Signal generator	Agilent E4438C	-	NA
Amplifier	Ophir 5163F	1022	NA

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 Phantoms

The phantoms used in SAR tests were the right and left head sections and the flat phantom section of the twin-headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEC 62209-1 and IEC 62209-2.

3.3 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528 and FCC published RF Exposure KDB Procedures. The dielectric parameters of the used tissue simulants were within ±10% of the recommended values in all frequencies used. 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.

3.4 System Validation Status

Frequency [MHz]	Dipole Type / SN	Probe Type / SN	Calibrated Signal Type	DAE Unit / SN	Dielectric Constant [ε] Head tissue simulant	Conductivity σ [S/m] Head tissue simulant	Validation Done
							Head tissue simulant
835	D835V2 - SN: 455	EX3DV4 - SN: 3892	CW	DAE 4 / 705	42.29	0.98	05.2019
1800	D1800V2 - SN: 2D075	EX3DV4 - SN: 3892	CW	DAE 4 / 705	40.29	1.46	05.2019

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 #
19.2.2020	**Wide Head**	22±2	835	250m	2.28	9.63	9.12	-5.3	1
19.2.2020	**Wide Head**	22±2	1800	250m	9.16	38.01	36.64	-3.6	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 (%)
19.2.2020	**Wide Head**	22	835	41.6	0.91	41.1	0.89	-1.1	-2.0
19.2.2020	**Wide Head**	22	847	41.5	0.92	41.0	0.90	-1.1	-2.0
19.2.2020	**Wide Head**	22	1747.5	40.1	1.37	38.4	1.28	-4.3	-6.6
19.2.2020	**Wide Head**	22	1800	40.0	1.40	38.3	1.30	-4.3	-6.9

4. TEST PROCEDURE

The device was set to transmit using maximum power with a communication tester.

4.1 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

4.2 Test Positions

4.2.1 Against Phantom Head

Measurements were made in “cheek” and “tilt” positions on both the left hand and right-hand sides of the phantom as specified by EN 62209-1. The phone was tested as it is and with the E-smog.

Photos of the test positions are presented in appendix A.

4.2.2 Body-worn 5 mm Configuration

The device was placed in the SPEAG holder the back side of the phone facing the phantom and placed below the flat phantom. The separation distance between the device and the phantom was 5mm. The same testing was done with the E-smog and with phone

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.

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.

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 %**	

6. TEST RESULTS

6.1 SAR Results for Head Exposure Condition

Phone only:

Band	Channel	Frequency	Modulation / BW [MHz]	RB Size	RB Offset	Power Drift [dB]	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
LTE 3	19575	1747.5	QPSK/ 20	1	0	-0.28	Right cheek	1:1	0.124	3
LTE 3	19575	1747.5	QPSK/ 20	1	0	0.09	Right Tilted	1:1	0.072	4
LTE 20	24300	847	QPSK/ 20	1	0	-0.26	Right cheek	1:1	0.068	
LTE 20	24300	847	QPSK/ 20	1	0	-0.06	Right Tilted	1:1	0.029	

Band	Channel	Frequency	Modulation / BW [MHz]	RB Size	RB Offset	Power Drift [dB]	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
LTE 3	19575	1747.5	QPSK/ 20	1	0	0.19	Left cheek	1:1	0.089	
LTE 3	19575	1747.5	QPSK/ 20	1	0	-0.12	Left Tilted	1:1	0.046	
LTE 20	24300	847	QPSK/ 20	1	0	0.03	Left cheek	1:1	0.062	
LTE 20	24300	847	QPSK/ 20	1	0	0.49	Left Tilted	1:1	0.041	

Phone with E-smog

Band	Channel	Frequency	Modulation / BW [MHz]	RB Size	RB Offset	Power Drift [dB]	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
LTE 3	19575	1747.5	QPSK/ 20	1	0	-0.56	Right cheek	1:1	0.090	5
LTE 3	19575	1747.5	QPSK/ 20	1	0	0.09	Right Tilted	1:1	0.053	6
LTE 20	24300	847	QPSK/ 20	1	0	-0.04	Right cheek	1:1	0.070	
LTE 20	24300	847	QPSK/ 20	1	0	-0.23	Right Tilted	1:1	0.033	

Band	Channel	Frequency	Modulation / BW [MHz]	RB Size	RB Offset	Power Drift [dB]	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
LTE 3	19575	1747.5	QPSK/ 20	1	0	0.04	Left cheek	1:1	0.041	
LTE 3	19575	1747.5	QPSK/ 20	1	0	-0.1	Left Tilted	1:1	0.018	
LTE 20	24300	847	QPSK/ 20	1	0	-0.1	Left cheek	1:1	0.062	
LTE 20	24300	847	QPSK/ 20	1	0	0.13	Left Tilted	1:1	0.04	

6.2 SAR Results for Body Exposure Condition, 5mm separation distance

Phone only:

Band	Channel	Frequency	Modulation / BW [MHz]	RB Size	RB Offset	Power Drift [dB]	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
LTE 3	19575	1747.5	QPSK/ 20	1	0	-0.25	Back	1:1	0.711	7
LTE 20	24300	847	QPSK/ 20	1	0	-0.24	Back	1:1	0.303	8

Phone with E-smog:

Band	Channel	Frequency	Modulation / BW [MHz]	RB Size	RB Offset	Power Drift [dB]	Test Position	Dudy Cycle	Measured SAR_{10g} [mW/g]	Plot #
LTE 3	19575	1747.5	QPSK/ 20	1	0	-0.13	Back	1:1	0.25	9
LTE 20	24300	847	QPSK/ 20	1	0	-0.06	Back	1:1	0.25	10

6.3 Result comparison

Band	Channel	Frequency	Test Position	Phone only	Phone with E-smog	Decrease in SAR result %
LTE 3	19575	1747.5	Right cheek	0.124	0.090	27.4
LTE 3	19575	1747.5	Right Tilted	0.072	0.053	26.4
LTE 3	19575	1747.5	Left cheek	0.089	0.041	53.9
LTE 3	19575	1747.5	Left Tilted	0.046	0.018	60.9
LTE 3	19575	1747.5	Back	0.711	0.25	64.8

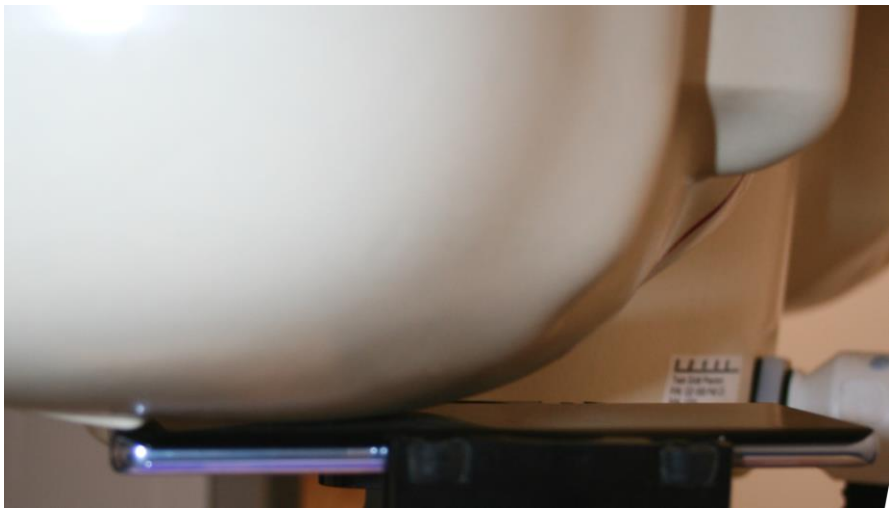
APPENDIX A: PHOTOS OF THE DUT

Size of the DUT:

The E-smog 100*67mm

The E-smog

The E-smog in the back of the device.



The right cheek position for phone only. The position is same for testing with the E-smog.

The tilt cheek position for phone only. The position is same for testing with the E-smog.

Back side of the device against the flat phantom with 5mm separation

Back side of the device with E-smog against the flat phantom with 5mm separation

APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 19.2.2020 12:57:12

Test Laboratory: Verkotan Oy

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:473

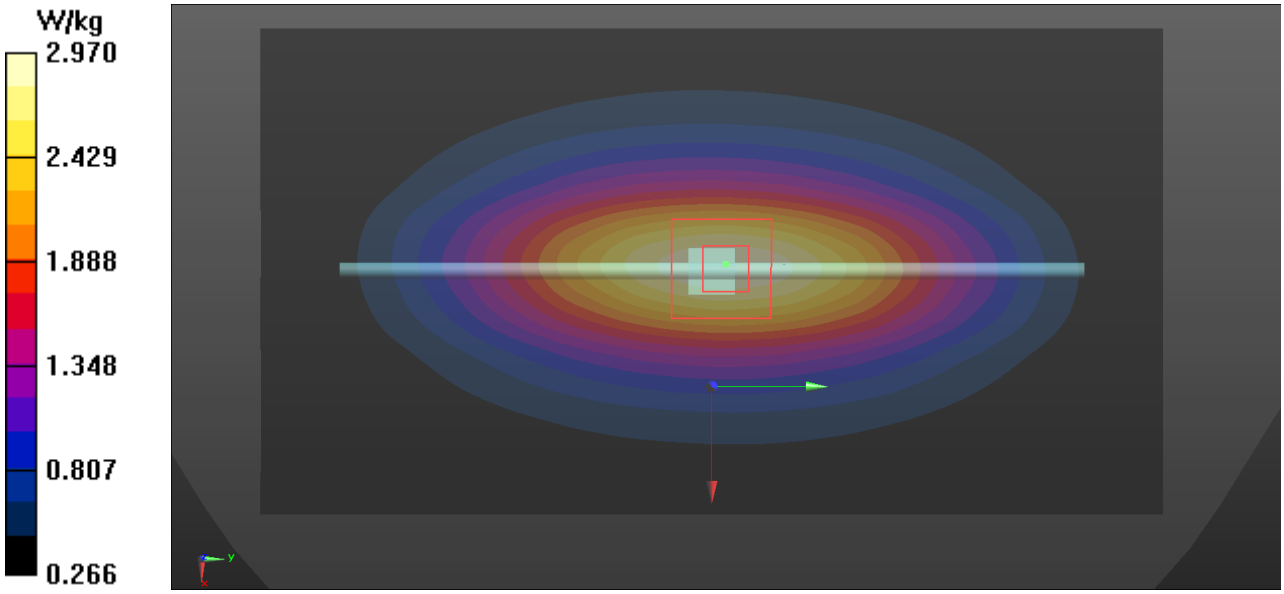
Communication System: UID 0, CW (0); Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 835 MHz; σ = 0.892 S/m; ε_r = 41.103; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.98, 9.98, 9.98); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

System Check/System check 835 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 61.45 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 3.31 W/kg
SAR(1 g) = 2.25 W/kg; SAR(10 g) = 1.48 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 2.97 W/kg

System Check/System check 835 MHz/Area Scan (71x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.88 W/kg



Plot 2

Date/Time: 19.2.2020 13:34:29

Test Laboratory: Verkotan Oy

DUT: Dipole 1800 MHz D1800V2; Type: D1800V2; Serial: D1800V2 - SN:2D075

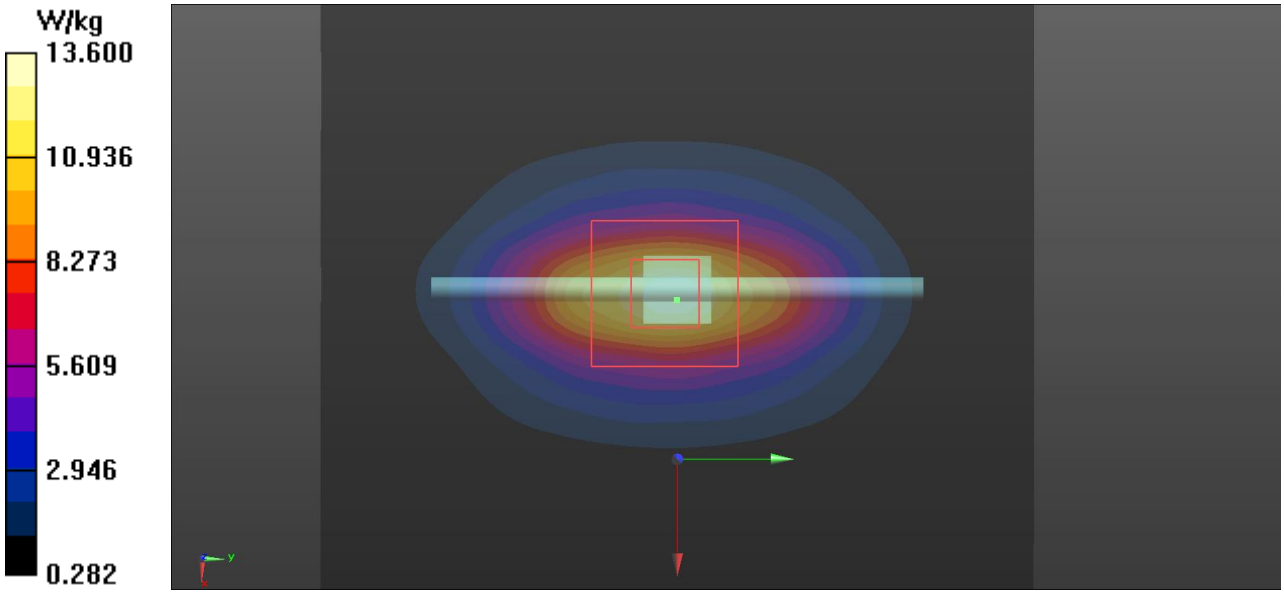
Communication System: UID 0, CW (0); Communication System Band: D1800 (1800.0 MHz); Frequency: 1800 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1800 MHz; σ = 1.304 S/m; ε_r = 38.262; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.69, 8.69, 8.69); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

System Check/System check 1800 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 105.2 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 16.0 W/kg
SAR(1 g) = 9.16 W/kg; SAR(10 g) = 4.81 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 13.6 W/kg

System Check/System check 1800 MHz/Area Scan (61x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.5 W/kg



APPENDIX C: MEASUREMENT SCAN

Plot 3

Date/Time: 20.2.2020 10:46:23

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; Phone only

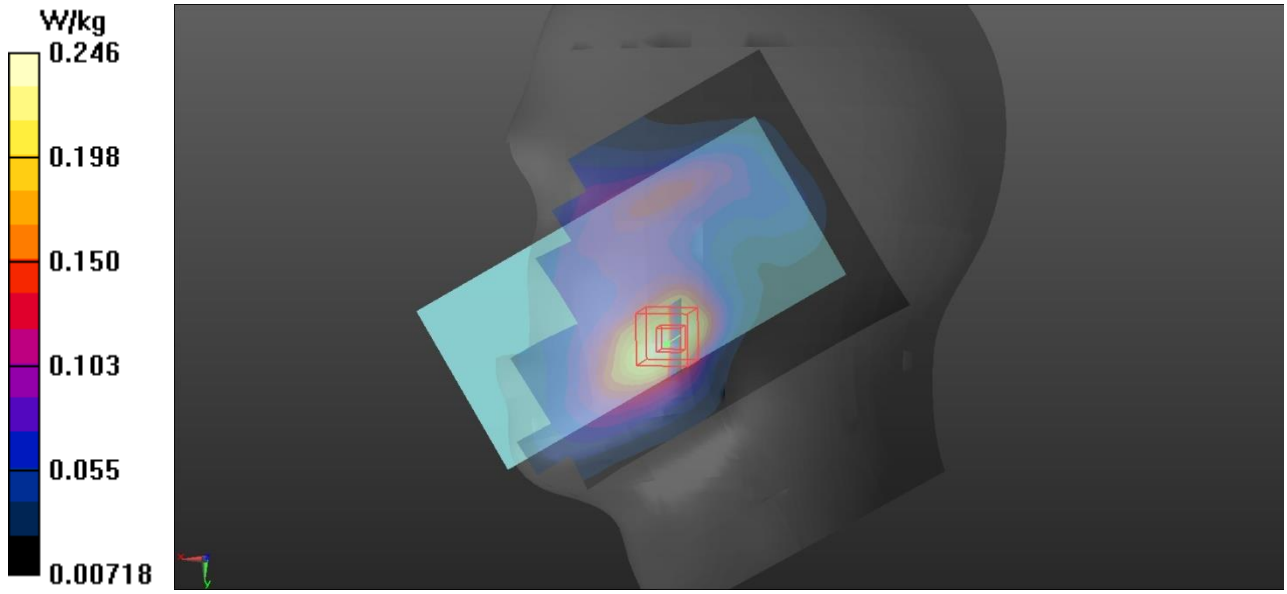
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz); Frequency: 1747.5 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1748 MHz; σ = 1.279 S/m; ε_r = 38.367; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.69, 8.69, 8.69); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -29.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/LTE 3 Phone only cheek/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 6.019 V/m; Power Drift = -0.28 dB
Peak SAR (extrapolated) = 0.283 W/kg
SAR(1 g) = 0.194 W/kg; SAR(10 g) = 0.124 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.246 W/kg

Configuration/LTE 3 Phone only cheek/Area Scan (81x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.272 W/kg



Plot 4

Date/Time: 20.2.2020 11:26:39

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; Phone only

Communication System: UID 0, Generic LTE (0); Communication System Band: Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz); Frequency: 1747.5 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1748 MHz; σ = 1.279 S/m; ε_r = 38.367; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY5 (IEEE/IEC)

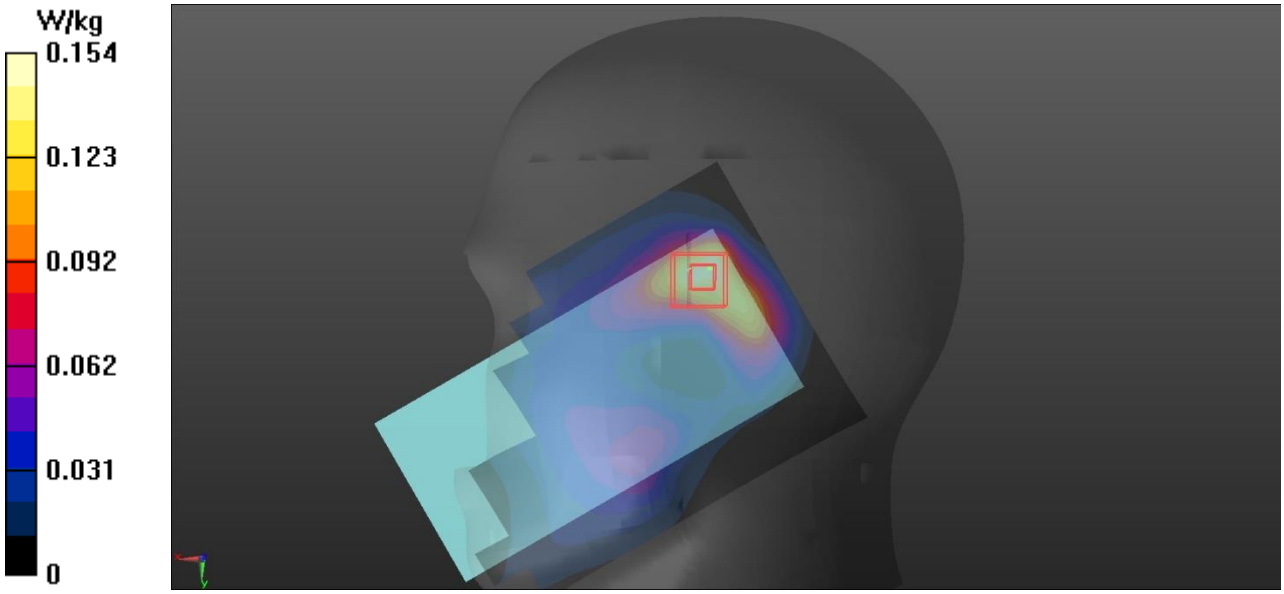
DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.69, 8.69, 8.69); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -29.0, 31.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/LTE 3 Phone only tilt/Area Scan (81x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.154 W/kg

Configuration/LTE 3 Phone only tilt/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 8.814 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.175 W/kg
SAR(1 g) = 0.116 W/kg; SAR(10 g) = 0.072 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.142 W/kg



Plot 5

Date/Time: 20.2.2020 15:19:31

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; E-smog

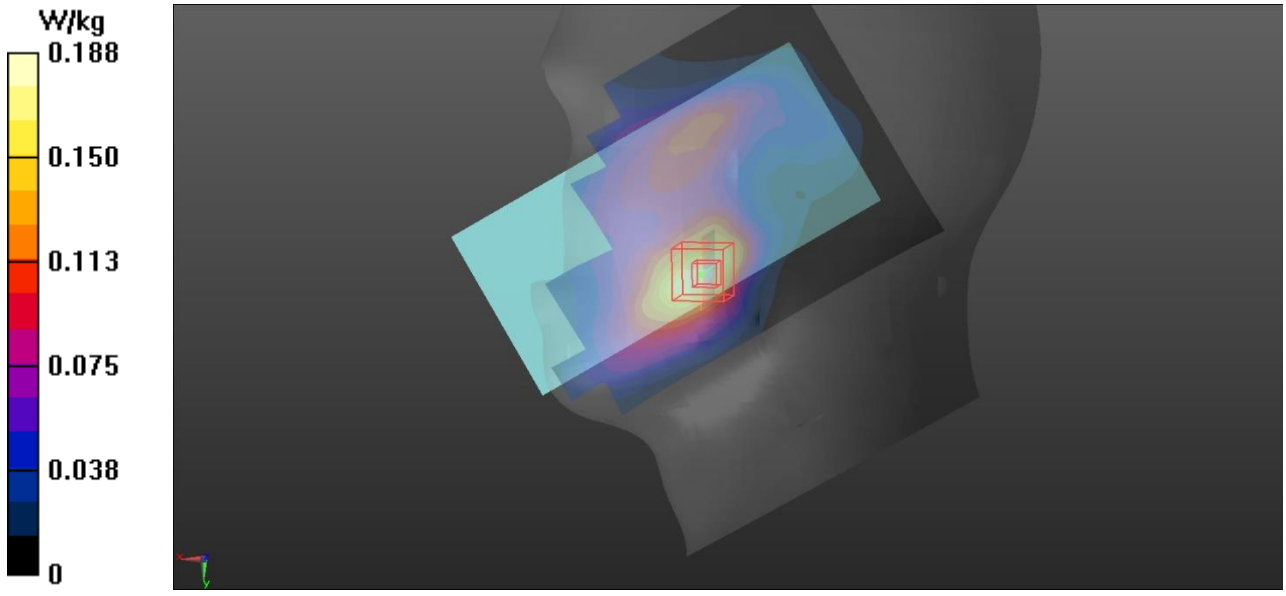
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz); Frequency: 1747.5 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1748 MHz; σ = 1.279 S/m; ε_r = 38.367; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.69, 8.69, 8.69); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -29.0, 31.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/LTE 3 Phone with E-smog cheek/Area Scan (81x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.188 W/kg

Configuration/LTE 3 Phone with E-smog cheek/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 5.058 V/m; Power Drift = -0.56 dB
Peak SAR (extrapolated) = 0.198 W/kg
SAR(1 g) = 0.137 W/kg; SAR(10 g) = 0.090 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.170 W/kg



Plot 6

Date/Time: 20.2.2020 16:11:28

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; E-smog

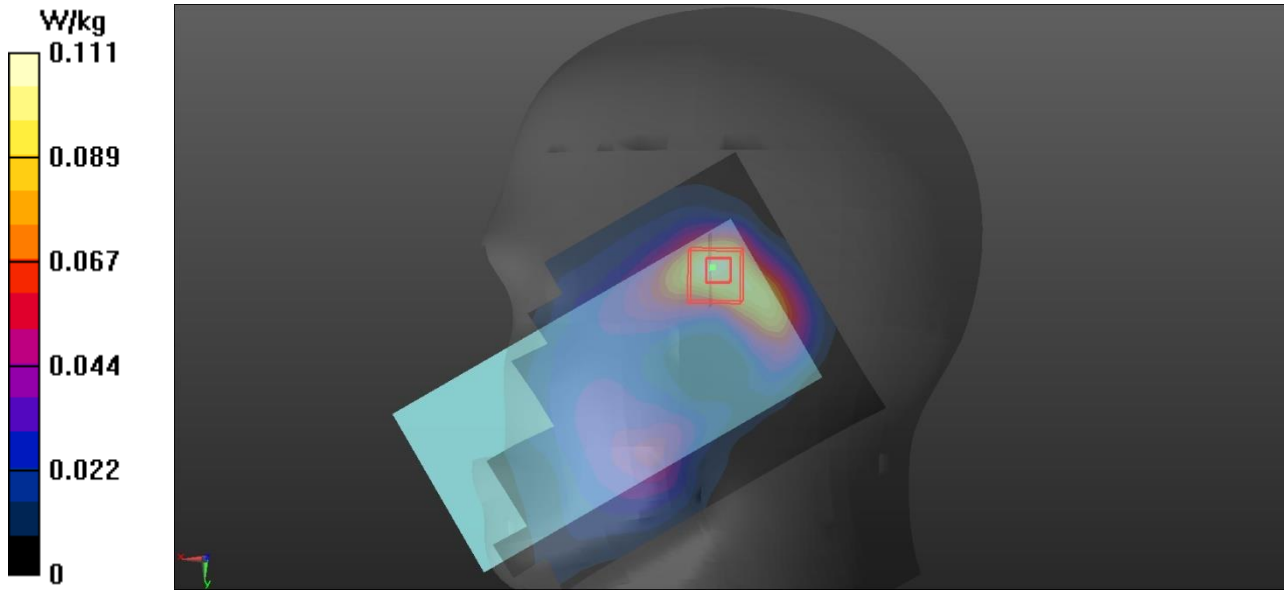
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz); Frequency: 1747.5 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1748 MHz; σ = 1.279 S/m; ε_r = 38.367; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.69, 8.69, 8.69); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -29.0, 31.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/LTE 3 Phone with E-smog cheek tilt/Area Scan (81x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.111 W/kg

Configuration/LTE 3 Phone with E-smog cheek tilt/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 7.635 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.130 W/kg
SAR(1 g) = 0.085 W/kg; SAR(10 g) = 0.053 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.106 W/kg



Plot 7

Date/Time: 24.2.2020 12:21:27

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; Phone only

Communication System: UID 0, Generic LTE (0); Communication System Band: Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz); Frequency: 1747.5 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1748 MHz; σ = 1.279 S/m; ε_r = 38.367; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

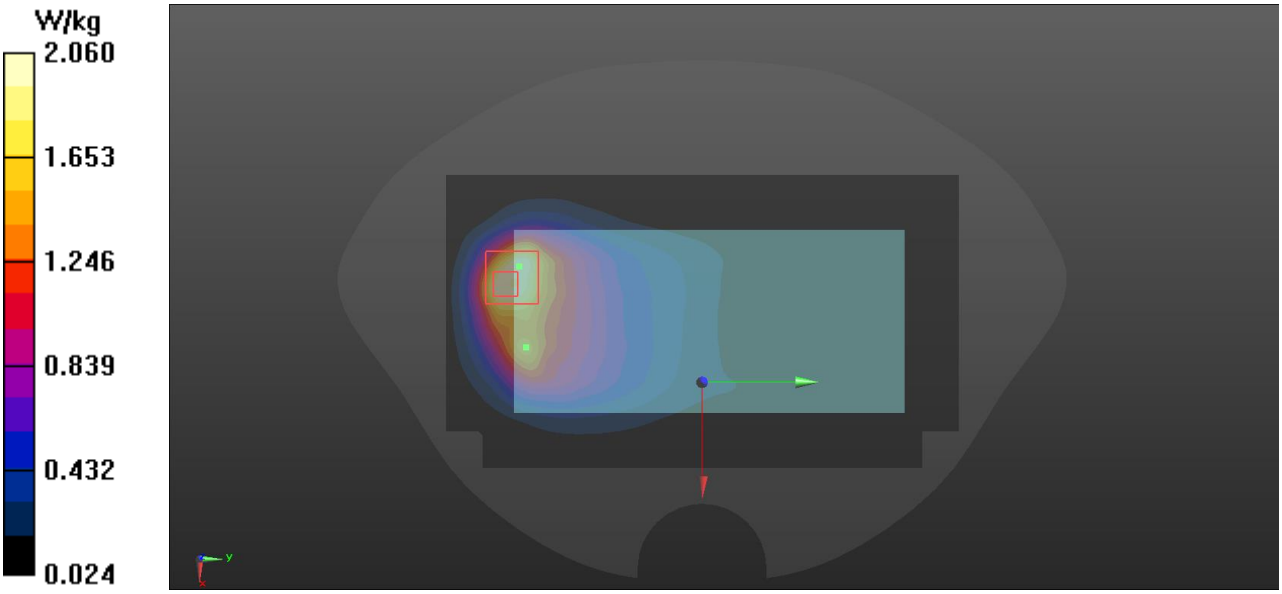
DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.69, 8.69, 8.69); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -29.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Back/LTE 3 Phone/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 10.31 V/m; Power Drift = -0.25 dB
Peak SAR (extrapolated) = 2.50 W/kg
SAR(1 g) = 1.37 W/kg; SAR(10 g) = 0.711 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 2.06 W/kg

Back/LTE 3 Phone/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.69 W/kg



Plot 8

Date/Time: 24.2.2020 12:43:12

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; Phone only

Communication System: UID 0, Generic LTE (0); Communication System Band: Band 20, E-UTRA/FDD (832.0 - 862.0 MHz); Frequency: 847 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 847 MHz; σ = 0.897 S/m; ε_r = 41.038; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

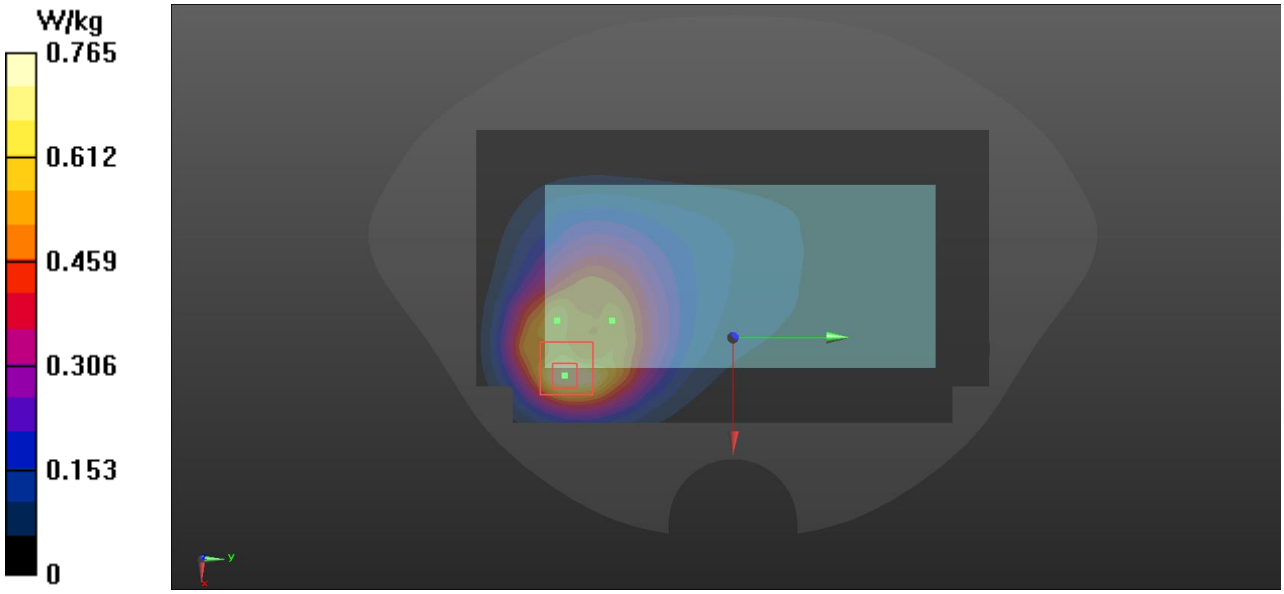
DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.98, 9.98, 9.98); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -29.0, 31.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Back/LTE 20 Phone 2/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.765 W/kg

Back/LTE 20 Phone 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 10.07 V/m; Power Drift = -0.24 dB
Peak SAR (extrapolated) = 0.985 W/kg
SAR(1 g) = 0.526 W/kg; SAR(10 g) = 0.303 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.823 W/kg



Plot 9

Date/Time: 24.2.2020 13:23:45

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; E-smog

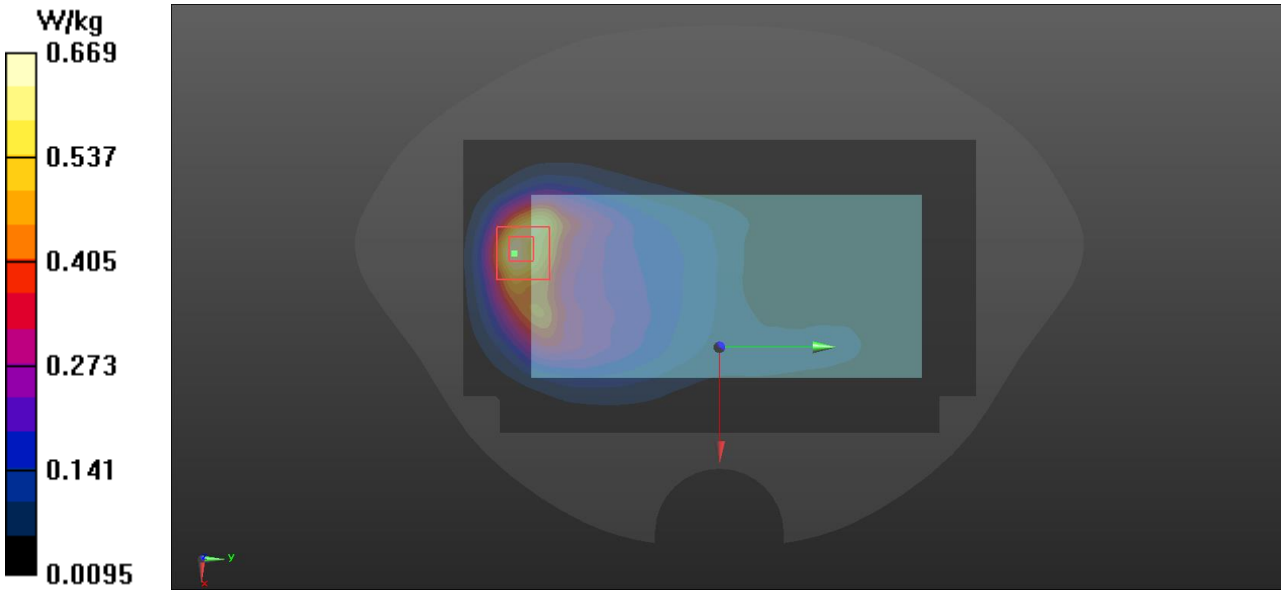
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 3, E-UTRA/FDD (1710.0 - 1785.0 MHz); Frequency: 1747.5 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1748 MHz; σ = 1.279 S/m; ε_r = 38.367; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.69, 8.69, 8.69); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -29.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Back/LTE 3 Phone with E-smog/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 7.042 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.810 W/kg
SAR(1 g) = 0.466 W/kg; SAR(10 g) = 0.250 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.669 W/kg

Back/LTE 3 Phone with E-smog/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.598 W/kg



Plot 10

Date/Time: 24.2.2020 13:07:51

Test Laboratory: Verkotan Oy

DUT: Spaceharmony limited; E-smog

Communication System: UID 0, Generic LTE (0); Communication System Band: Band 20, E-UTRA/FDD (832.0 - 862.0 MHz); Frequency: 847 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 847 MHz; σ = 0.897 S/m; ε_r = 41.038; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

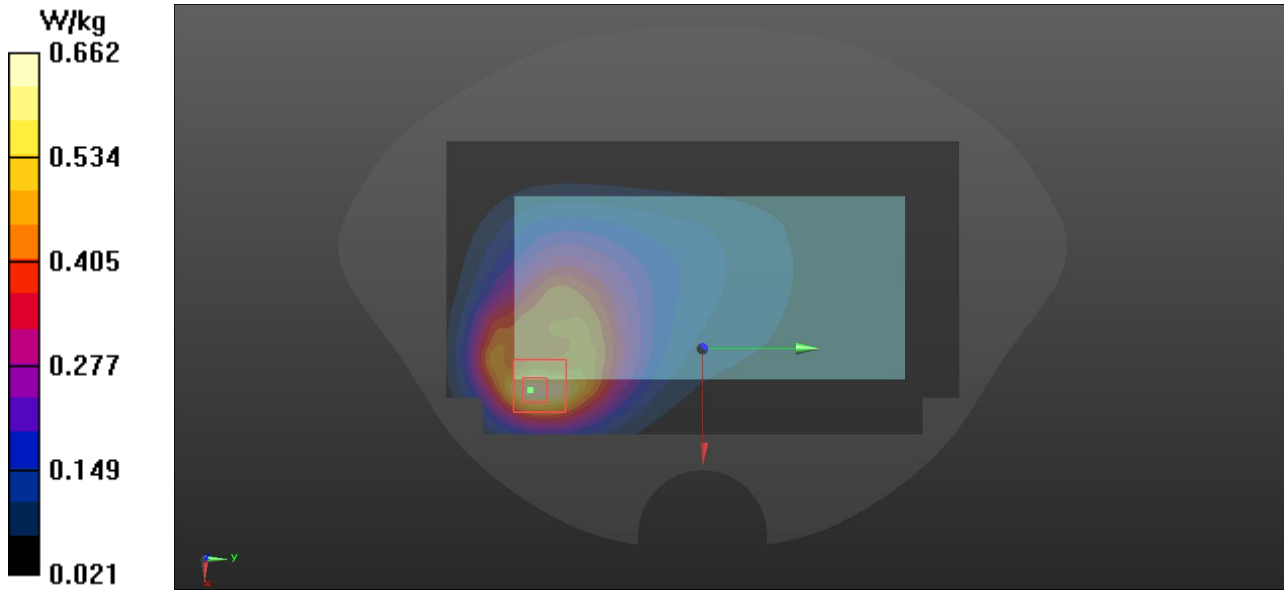
DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.98, 9.98, 9.98); Calibrated: 23.4.2019;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -29.0
- Electronics: DAE4 Sn1332; Calibrated: 15.10.2019
- Phantom: SAR1_Phantom 2_Twin-SAM_right; Type: QD 000 P40 CC
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Back/LTE 20 Phone with E-smog/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 9.806 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.795 W/kg
SAR(1 g) = 0.431 W/kg; SAR(10 g) = 0.249 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.662 W/kg
Back/LTE 20 Phone with E-smog/Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.611 W/kg



APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION

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
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client Verkotan **Certificate No: EX3-3892_Apr19**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3892
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes
Calibration date:	April 23, 2019

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	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 25, 2019

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	10.63	10.63	10.63	0.49	0.80	± 12.0 %
900	41.5	0.97	9.98	9.98	9.98	0.51	0.85	± 12.0 %
1750	40.1	1.37	8.69	8.69	8.69	0.39	0.80	± 12.0 %
1900	40.0	1.40	8.46	8.46	8.46	0.41	0.84	± 12.0 %
2450	39.2	1.80	7.56	7.56	7.56	0.41	0.85	± 12.0 %
2600	39.0	1.96	7.51	7.51	7.51	0.35	0.91	± 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. 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 E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS

SAR Reference Dipole Calibration Report

Ref : ACR.353.2.18.SATU.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: SN 51/18 DIP 0G835-473

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

Calibration Date: 12/19/18

Summary:

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

1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
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 %		1.80 ±5 %	
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' : 40.0 sigma : 0.90
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	835 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	9.63 (0.96)	6.22	6.19 (0.62)
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	

SAR Reference Dipole Calibration Report

Ref : ACR.165.30.17.SATU.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
SAR REFERENCE DIPOLE
FREQUENCY: 1800 MHZ
SERIAL NO.: D1800V2-2D075

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.

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 %		1.80 ±5 %	
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' : 41.7 sigma : 1.46
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	1800 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	38.01 (3.80)	20.1	20.02 (2.00)
1900	39.7		20.5	
1950	40.5		20.9	