

SAR Compliance Test Report

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	Number of pages: 67		
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Testing laboratory:	Verkotan Oy Elektroniikkatie 17 90590 Oulu Finland	Client:	German Bionic Systems GmbH August-Wessels Str. 23 86156 Augsburg German
Tested device	Cray X		
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 IEEE 1528:2013 IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques 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:	23.05.2023 Laboratory Manager		

TABLE OF CONTENTS

1. SUMMARY OF SAR TEST REPORT	3
1.1 TEST DETAILS	3
1.2 MAXIMUM RESULTS.....	3
1.2.1 Standalone SAR.....	4
1.2.2 Simultaneous Transmission SAR.....	4
1.2.3 Maximum Drift.....	4
1.2.4 Measurement Uncertainty.....	4
2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT).....	5
2.1 SUPPORTED FREQUENCY BANDS AND OPERATIONAL MODES.....	6
2.2 TEST EXCLUSIONS.....	6
2.3 SIMULTANEOUS TRANSMISSION.....	6
3. OUTPUT POWER	7
3.1 MAXIMUM SPECIFIED CONDUCTED OUTPUT POWER.....	7
3.2 TESTED CONDUCTED POWER	8
4. TEST EQUIPMENT	16
4.1 TEST EQUIPMENT LIST.....	17
4.1.1 Isotropic E-field Probe Type EX3DV4.....	17
4.2 PHANTOMS.....	18
4.3 TISSUE SIMULANTS	18
4.4 SYSTEM VALIDATION STATUS.....	19
4.5 SYSTEM CHECK	19
4.5.1 Tissue Simulant Verification	20
5. TEST PROCEDURE	21
5.1 TEST POSITIONS	21
5.1.1 Body-worn Configuration, 0mm separation distance.....	21
5.2 SCAN PROCEDURES.....	22
5.3 SAR AVERAGING METHODS.....	22
6. MEASUREMENT UNCERTAINTY.....	23
7. TEST RESULTS.....	24
7.1 SAR RESULTS FOR BODY EXPOSURE CONDITION WITH 0MM SEPARATION	24
7.2 IEC 62209-2 AMD1:2019.....	26
7.3 SIMULTANEOUS TRANSMISSION ANALYSIS.....	26
APPENDIX A: PHOTOS OF THE DUT.....	27
APPENDIX B: SYSTEM CHECK SCAN	28
APPENDIX C: MEASUREMENT SCANS	36
APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS.....	46
APPENDIX E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS.....	54

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (DUT):

Product:	Exoskeleton
Manufacturer:	German Bionic Systems GmbH
Model:	Cray X
Serial Number:	99-99-00-09
FCC ID Number:	FCC ID: VVX-LM811-04XX
ISED ID Number:	IC: 10531A-LM811, 23761-8PYA008
DUT Number:	21354
Battery Type used in testing:	Li-Ion Battery
State of the Sample:	Production sample

Testing information:

Testing performed:	01.03.2023 – 22.03.2023
Notes:	Added IEEE standard.
Document history:	This report replaces previous "FCC ISED_SAR report_Cray X ID5977c_11042023.pdf" report.
Document ID:	FCC ISED_SAR report_Cray X ID5977c_23052023.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

1.2 Maximum Results

The maximum reported* SAR values for Body-worn for transmitting systems are shown in a table below. The device conforms to the requirements of the standards when the maximum reported SAR value is less than or equal to the limit. The SAR limit specified in FCC 47 CFR part 2 (2.1093) and Health Canada's RF exposure guideline, Safety Code 6 for 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
WCDMA 2	0.000019	PASS
WCDMA 4	0.00029	PASS
WCDMA 5	0.0030	PASS
LTE 2	0.0016	PASS
LTE 5	0.0062	PASS
LTE 7	0.0051	PASS
LTE 12	0.0083	PASS
LTE 13	0.020	PASS
LTE 66	0.000013	PASS
2.4 GHz WLAN	0.00000002	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
LTE 13 + 2.4 GHz WLAN	0.02

1.2.3 Maximum Drift

Maximum Drift During Measurements	0.85 dB
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*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 an exoskeleton which supports user's movements and reduces risk of workplace accidents and load-bearing injuries. Supported wireless standards are WCDMA, LTE and WLAN.

All the modules and antennas are located on the yellow unit behind the user. See section 5.1.1 for more details.



Figure 1. Overview of the DUT

Device Category	Portable
Exposure Environment	General population uncontrolled

2.1 Supported Frequency Bands and Operational Modes

TX Frequency bands	Modes of Operation	Transmitter Frequency Range [MHz]
	WCDMA 2	1850 – 1910
	WCDMA 4	1710 – 1755
	WCDMA 5	824 – 849
	LTE 2	1850 – 1910
	LTE 4	1710 – 1755
	LTE 5	824 – 849
	LTE 7	2500 – 2570
	LTE 12	698 – 716
	LTE 13	777 – 787
	LTE 66	1710 – 1780
	WLAN 2.4 GHz	2412 – 2462

2.2 Test Exclusions

According to April 2015 TCB workshop, SAR test exclusion can be applied for testing overlapping LTE bands when the specified maximum output power, including tune-up tolerance, is less or same for the smaller band as for the larger band.

The channel bandwidth and other operating parameters for the smaller band must be fully supported by the larger band.

For this product:

- LTE 4 band, 1710-1755 MHz, is excluded from the testing as it is fully covered by LTE 66 band, 1710 – 1780 MHz

2.3 Simultaneous transmission

Cellular and WLAN 2.4GHz can be operated simultaneously.

3. OUTPUT POWER

3.1 Maximum specified conducted output power

From the customer, including tune-up tolerances;

WCDMA	Max Output Power [dBm]
2	25
4	25
5	25

LTE	Max Output Power [dBm]
2	25.7
4	25.7
5	25.7
7	25.7
12	25.7
13	25.7
66	25.7

WLAN 2.4GHz	Max Output Power [dBm]
802.11b	17
802.11g	15
802.11n	13

3.2 Tested conducted power

Measured conducted output power at transmitting antenna connector;

WCDMA:

Reference Channel	WCDMA 2			WCDMA 4			WCDMA 5		
	CH 9262 1852.4 MHz	CH 9400 1880.0 MHz	CH 9538 1907.6 MHz	CH 1312 1712.4 MHz	CH 1413 1732.6 MHz	CH 1513 1752.6 MHz	CH 4132 826.4 MHz	CH 4183 836.6 MHz	CH 4233 846.6 MHz
RMC 12.2K	24.46	24.53	24.64	23.9	22.16	23.51	23.47	23.26	23.3
HSDPA Subtest-1	23.4	23.38	23.58	22.85	21.42	22.59	22.47	22.28	22.2
HSDPA Subtest-2	23.42	23.4	23.61	22.66	21.42	22.53	22.35	22.21	22.26
HSDPA Subtest-3	23.06	22.96	23.14	22.15	20.94	21.96	21.76	21.64	21.58
HSDPA Subtest-4	23.01	22.98	23.18	22.08	20.9	22.07	21.83	21.61	21.64
HSUPA Subtest-1	23.53	23.49	23.6	22.89	21.49	22.59	22.45	22.28	22.26
HSUPA Subtest-2	23.0	22.97	23.19	22.14	20.92	21.99	21.82	21.66	21.68
HSUPA Subtest-3	23.48	23.45	23.63	22.66	21.38	22.48	22.44	22.12	22.15
HSUPA Subtest-4	23.56	23.49	23.65	22.64	21.21	22.34	22.24	22.08	22.14
HSUPA Subtest-5	23.48	23.49	23.62	22.49	21.25	22.38	22.34	22.12	22.05

LTE:

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 18607 1850.7 MHz	CH 18900 1880.0 MHz	CH 19193 1909.3 MHz	3GPP MPR [dB]	CH 18607 1850.7 MHz	CH 18900 1880.0 MHz	CH 19193 1909.3 MHz	3GPP MPR [dB]
2 / 1.4M	1	0	22.98	22.4	23.02	0	21.58	20.93	21.52	1
	1	2	22.99	22.54	23.11	0	21.13	20.96	21.44	1
	1	5	22.9	22.53	23.09	0	21.1	20.94	21.52	1
	3	0	23.02	22.61	23.09	0	21.95	21.43	22.18	1
	3	1	22.96	22.56	23.13	0	22.01	21.58	22.25	1
	3	3	22.93	22.48	23.03	0	21.98	21.48	22.24	1
	6	0	21.91	21.53	22.19	1	21.03	20.4	21.65	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 18615 1851.5 MHz	CH 18900 1880.0 MHz	CH 19185 1918.5 MHz	3GPP MPR [dB]	CH 18615 1851.5 MHz	CH 18900 1880.0 MHz	CH 19185 1918.5 MHz	3GPP MPR [dB]
2 / 3M	1	0	22.75	22.39	22.98	0	21.45	20.63	21.86	1
	1	7	22.96	22.75	23.11	0	21.88	21.35	21.89	1
	1	14	22.8	22.56	23.0	0	21.41	20.7	21.43	1
	8	0	21.95	21.51	22.2	1	21.0	20.5	21.25	2
	8	3	22.01	21.54	22.09	1	20.88	20.43	21.15	2
	8	7	22.01	21.48	22.11	1	20.86	20.55	20.95	2
	15	0	21.95	21.47	22.16	1	21.12	20.61	21.21	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 18625 1852.5 MHz	CH 18900 1880.0 MHz	CH 19175 1907.5 MHz	3GPP MPR [dB]	CH 18625 1852.5 MHz	CH 18900 1880.0 MHz	CH 19175 1907.5 MHz	3GPP MPR [dB]
2 / 5M	1	0	22.55	22.35	22.99	0	21.37	21.29	21.38	1
	1	12	22.66	22.36	22.99	0	21.41	21.43	21.95	1
	1	24	22.47	22.29	22.88	0	21.21	20.96	21.41	1
	12	0	21.91	21.44	22.19	1	20.63	20.34	21.1	2
	12	6	21.9	21.37	22.21	1	20.68	20.61	21.35	2
	12	13	21.74	21.36	22.08	1	20.87	20.46	20.92	2
	25	0	21.89	21.47	22.17	1	20.93	20.48	21.13	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 18650 1855 MHz	CH 18900 1880.0	CH 19150 1905 MHz	3GPP MPR [dB]	CH 18650 1855 MHz	CH 18900 1880.0 MHz	CH 19150 1905 MHz	3GPP MPR [dB]
2 / 10M	1	0	22.72	22.58	22.86	0	21.58	21.04	21.47	1
	1	24	22.78	22.5	23.08	0	21.39	20.84	21.61	1
	1	49	22.43	22.41	22.67	0	20.95	20.8	21.43	1
	25	0	22.0	21.55	22.19	1	20.92	20.37	21.1	2
	25	12	21.82	21.54	22.15	1	20.85	20.43	21.03	2
	25	25	21.62	21.46	22.15	1	20.56	20.43	21.11	2
	50	0	21.86	21.47	22.14	1	20.87	20.49	21.15	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 18675 1857.5 MHz	CH 18900 1880.0	CH 19125 1902.5 MHz	3GPP MPR [dB]	CH 18675 1857.5 MHz	CH 18900 1880.0 MHz	CH 19125 1902.5 MHz	3GPP MPR [dB]
2 / 15M	1	0	22.78	22.45	22.6	0	21.5	21.16	21.58	1
	1	37	22.7	22.8	23.15	0	21.58	21.25	21.82	1
	1	74	22.4	22.56	22.5	0	21.08	20.98	21.68	1
	36	0	22.04	21.47	22.01	1	21.11	20.42	21.11	2
	36	19	21.83	21.51	22.17	1	20.9	20.64	21.07	2
	36	39	21.66	21.52	22.05	1	20.62	20.54	21.05	2
	75	0	21.83	21.53	22.08	1	20.79	20.65	21.07	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 18700 1860.0 MHz	CH 18900 1880.0	CH 19100 1900.0 MHz	3GPP MPR [dB]	CH 18700 1860.0 MHz	CH 18900 1880.0	CH 19100 1900.0 MHz	3GPP MPR [dB]
2 / 20M	1	0	23.01	22.62	22.58	0	21.29	20.78	21.02	1
	1	50	22.92	22.71	22.88	0	21.38	21.34	21.82	1
	1	99	22.51	22.63	22.22	0	20.83	20.89	21.47	1
	50	0	22.03	21.63	21.98	1	21.0	20.6	20.98	2
	50	25	21.86	21.58	22.09	1	21.0	20.69	21.11	2
	50	50	21.65	21.62	22.06	1	20.65	20.58	21.22	2
	100	0	21.81	21.59	22.07	1	20.92	20.58	21.03	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 19957 1710.7 MHz	CH 20175 1732.5 MHz	CH 20393 1754.3 MHz	3GPP MPR [dB]	CH 19957 1710.7 MHz	CH 20175 1732.5 MHz	CH 20393 1754.3 MHz	3GPP MPR [dB]
4 / 1.4M	1	0	23.83	23.45	23.69	0	22.69	22.04	22.32	1
	1	2	23.97	23.52	23.85	0	22.54	22.13	22.49	1
	1	5	23.84	23.52	23.69	0	22.57	21.91	22.44	1
	3	0	23.78	23.46	23.7	0	22.72	22.71	22.73	1
	3	1	23.89	23.52	23.79	0	22.83	22.74	22.91	1
	3	3	23.81	23.52	23.76	0	22.82	22.75	22.9	1
	6	0	22.86	22.75	22.76	1	22.36	21.86	21.98	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 19965 1711.5 MHz	CH 20175 1732.5 MHz	CH 20385 1753.5 MHz	3GPP MPR [dB]	CH 19965 1711.5 MHz	CH 20175 1732.5 MHz	CH 20385 1753.5 MHz	3GPP MPR [dB]
4 / 3M	1	0	23.76	23.35	23.54	0	22.54	22.41	22.3	1
	1	7	23.79	23.54	23.62	0	22.66	22.21	22.52	1
	1	14	23.82	23.55	23.49	0	22.3	21.96	22.43	1
	8	0	23.01	22.88	22.73	1	21.92	21.66	21.7	2
	8	3	22.98	22.78	22.73	1	21.83	21.72	21.77	2
	8	7	23.0	22.8	22.63	1	21.77	21.67	21.68	2
	15	0	22.98	22.75	22.69	1	21.92	21.77	21.82	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 19975 1711.5 MHz	CH 20175 1732.5 MHz	CH 20375 1753.5 MHz	3GPP MPR [dB]	CH 19975 1711.5 MHz	CH 20175 1732.5 MHz	CH 20375 1753.5 MHz	3GPP MPR [dB]
4 / 5M	1	0	23.75	23.18	23.63	0	22.57	22.38	22.37	1
	1	12	23.93	23.45	23.8	0	22.54	22.27	22.41	1
	1	24	23.81	23.55	23.7	0	22.43	22.06	22.38	1
	12	0	22.96	22.8	22.7	1	21.74	21.66	21.54	2
	12	6	23.04	22.67	22.69	1	21.74	21.59	21.62	2
	12	13	22.88	22.74	22.69	1	21.82	21.75	21.73	2
	25	0	22.89	22.73	22.77	1	21.79	21.67	21.86	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20000 1715.0 MHz	CH 20175 1732.5 MHz	CH 20350 1750.0 MHz	3GPP MPR [dB]	CH 20000 1715.0 MHz	CH 20175 1732.5 MHz	CH 20350 1750.0 MHz	3GPP MPR [dB]
4 / 10M	1	0	23.83	22.3	23.63	0	22.65	21.7	22.35	1
	1	24	23.95	23.39	23.97	0	22.37	22.8	22.48	1
	1	49	22.66	22.95	23.85	0	21.95	22.3	22.23	1
	25	0	23.01	22.99	22.94	1	21.99	21.85	21.77	2
	25	12	22.84	22.81	22.93	1	21.85	21.79	21.98	2
	25	25	22.64	22.7	22.86	1	21.64	21.66	21.77	2
	50	0	22.85	22.7	22.83	1	21.92	21.66	21.86	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20025 1717.0 MHz	CH 20175 1732.5 MHz	CH 20325 1747.5 MHz	3GPP MPR [dB]	CH 20025 1717.0 MHz	CH 20175 1732.5 MHz	CH 20325 1747.5 MHz	3GPP MPR [dB]
4 / 15M	1	0	23.97	22.17	23.5	0	22.54	21.46	22.23	1
	1	37	23.76	23.36	23.97	0	22.6	22.66	22.73	1
	1	74	22.11	23.27	23.8	0	21.36	22.18	22.24	1
	36	0	22.9	22.89	22.83	1	21.99	21.68	21.72	2
	36	19	22.74	22.81	22.91	1	21.86	21.63	21.86	2
	36	39	22.65	22.7	22.83	1	21.71	21.59	21.89	2
	75	0	22.94	22.7	22.72	1	21.99	21.61	21.77	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20050 1720.0 MHz	CH 20175 1732.5 MHz	CH 20300 1745.0 MHz	3GPP MPR [dB]	CH 20050 1720.0 MHz	CH 20175 1732.5 MHz	CH 20300 1745.0 MHz	3GPP MPR [dB]
4 / 20M	1	0	24.05	22.25	22.69	0	22.73	21.45	21.84	1
	1	50	23.78	23.53	23.74	0	22.58	22.64	22.74	1
	1	99	22.16	23.53	23.68	0	21.31	22.29	22.4	1
	50	0	23.02	22.81	22.67	1	21.99	21.71	21.69	2
	50	25	22.84	22.77	22.82	1	21.83	21.79	21.82	2
	50	50	22.8	22.56	22.81	1	21.73	21.74	21.83	2
	100	0	23.0	22.59	22.61	1	21.96	21.71	21.62	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20407 824.7 MHz	CH 20525 836.5 MHz	CH 20643 848.3 MHz	3GPP MPR [dB]	CH 20407 824.7 MHz	CH 20525 836.5 MHz	CH 20643 848.3 MHz	3GPP MPR [dB]
5 / 1.4M	1	0	23.21	22.87	23.04	0	21.83	21.66	21.81	1
	1	2	23.26	22.88	23.24	0	21.74	21.72	21.97	1
	1	5	23.06	22.77	23.14	0	21.73	21.73	21.58	1
	3	0	23.39	22.98	23.3	0	22.27	22.05	22.11	1
	3	1	23.34	23.05	23.26	0	22.31	22.14	22.22	1
	3	3	23.28	23.05	23.25	0	22.22	22.11	22.17	1
	6	0	22.29	22.04	22.2	1	21.37	21.15	21.39	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20415 825.5 MHz	CH 20525 836.5 MHz	CH 20635 847.5 MHz	3GPP MPR [dB]	CH 20415 825.5 MHz	CH 20525 836.5 MHz	CH 20635 847.5 MHz	3GPP MPR [dB]
5 / 3M	1	0	23.31	23.21	23.27	0	21.88	21.69	21.77	1
	1	7	22.96	23.0	23.37	0	22.04	21.84	21.88	1
	1	14	23.07	22.8	23.13	0	21.61	21.5	21.45	1
	8	0	22.26	22.25	22.27	1	21.12	21.14	21.16	2
	8	3	22.18	22.18	22.27	1	21.02	21.05	21.1	2
	8	7	22.19	22.05	22.27	1	20.96	20.91	21.09	2
	15	0	22.13	22.15	22.25	1	21.14	21.18	21.34	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20425 826.5 MHz	CH 20525 836.5 MHz	CH 20625 846.5 MHz	3GPP MPR [dB]	CH 20425 826.5 MHz	CH 20525 836.5 MHz	CH 20625 846.5 MHz	3GPP MPR [dB]
5 / 5M	1	0	23.04	23.05	22.96	0	21.68	21.9	21.54	1
	1	12	23.26	22.97	23.26	0	22.01	21.8	21.8	1
	1	24	23.12	22.76	22.89	0	21.72	21.19	21.37	1
	12	0	22.06	22.19	22.2	1	20.93	20.84	20.98	2
	12	6	22.08	22.25	22.29	1	20.95	21.03	21.0	2
	12	13	22.19	22.05	22.21	1	20.93	20.9	20.82	2
	25	0	22.08	22.23	22.18	1	21.03	21.07	20.99	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20450 829.0 MHz	CH 20525 836.5 MHz	CH 20600 844 MHz	3GPP MPR [dB]	CH 20450 829.0 MHz	CH 20525 836.5 MHz	CH 20600 844 MHz	3GPP MPR [dB]
5 / 10M	1	0	23.44	23.14	23.0	0	21.5	21.61	21.68	1
	1	24	23.55	23.08	22.99	0	22.0	21.37	21.66	1
	1	49	23.13	22.97	23.08	0	21.24	21.4	21.6	1
	25	0	22.17	22.19	22.19	1	21.12	21.16	21.06	2
	25	12	22.33	22.23	22.08	1	21.23	21.12	21.09	2
	25	25	22.17	22.08	22.13	1	21.11	20.95	20.99	2
	50	0	22.12	22.23	22.11	1	21.18	21.2	21.08	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20775 2502.5 MHz	CH 21100 2535.0 MHz	CH 21425 2567.5 MHz	3GPP MPR [dB]	CH 20775 2502.5 MHz	CH 21100 2535.0 MHz	CH 21425 2567.5 MHz	3GPP MPR [dB]
7 / 5M	1	0	23.77	24.44	21.69	0	23.2	23.9	21.46	1
	1	12	24.11	24.36	20.54	0	23.59	23.89	20.32	1
	1	24	24.04	23.84	19.08	0	23.47	23.4	18.83	1
	12	0	23.98	24.46	21.19	1	23.36	23.49	20.94	2
	12	6	24.12	24.39	20.61	1	23.53	23.55	20.36	2
	12	13	24.14	24.15	19.82	1	23.53	23.52	19.57	2
	25	0	24.05	24.3	20.57	1	23.46	23.4	20.34	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20800 2505.0 MHz	CH 21100 2535.0 MHz	CH 21400 2565.0 MHz	3GPP MPR [dB]	CH 20800 2505.0 MHz	CH 21100 2535.0 MHz	CH 21400 2565.0 MHz	3GPP MPR [dB]
7 / 10M	1	0	23.37	24.29	23.68	0	22.83	23.79	23.35	1
	1	24	24.27	24.36	22.05	0	23.73	23.9	21.85	1
	1	49	24.02	23.19	18.98	0	23.47	22.72	18.71	1
	25	0	23.94	24.45	23.02	1	23.35	23.46	22.73	2
	25	12	24.24	24.34	22.08	1	23.67	23.5	21.84	2
	25	25	24.25	23.89	20.71	1	23.64	23.39	20.48	2
	50	0	24.09	24.17	22.03	1	23.44	23.54	21.76	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20825 2507.5 MHz	CH 21100 2535.0 MHz	CH 21375 2562.5 MHz	3GPP MPR [dB]	CH 20825 2507.5 MHz	CH 21100 2535.0 MHz	CH 21375 2562.5 MHz	3GPP MPR [dB]
7 / 15M	1	0	23.86	24.94	24.48	0	22.99	23.82	23.66	1
	1	37	25.09	24.81	23.68	0	24.14	23.96	23.1	1
	1	74	24.99	23.27	19.59	0	24.03	22.56	18.95	1
	36	0	24.3	24.21	24.57	1	23.53	23.29	23.88	2
	36	19	24.38	24.42	23.62	1	23.48	23.4	23.03	2
	36	39	24.19	24.17	21.87	1	23.4	23.29	21.29	2
	75	0	24.37	24.53	23.33	1	23.38	23.52	22.7	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 20850 2510.0 MHz	CH 21100 2535.0 MHz	CH 21350 2560.0 MHz	3GPP MPR [dB]	CH 20850 2510.0 MHz	CH 21100 2535.0 MHz	CH 21350 2560.0 MHz	3GPP MPR [dB]
7 / 20M	1	0	24.59	24.74	23.4	0	23.35	23.44	22.56	1
	1	50	24.98	25.31	25.55	0	24.24	24.14	24.61	1
	1	99	24.78	23.72	21.11	0	23.75	22.67	19.96	1
	50	0	23.99	23.99	24.51	1	23.19	23.12	23.72	2
	50	25	23.96	24.09	24.39	1	23.29	23.25	23.64	2
	50	50	23.78	24.23	23.75	1	22.89	23.32	22.8	2
	100	0	23.97	24.25	24.51	1	23.1	23.34	23.51	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 23017 699.7 MHz	CH 23095 707.5 MHz	CH 23173 715.3 MHz	3GPP MPR [dB]	CH 23017 699.7 MHz	CH 23095 707.5 MHz	CH 23173 715.3 MHz	3GPP MPR [dB]
12 / 1.4M	1	0	22.49	22.49	22.37	0	21.56	21.38	21.26	1
	1	2	22.62	22.6	22.5	0	21.83	21.54	21.27	1
	1	5	22.46	22.61	22.58	0	21.69	21.45	21.47	1
	3	0	22.58	22.69	22.45	0	21.5	21.59	21.31	1
	3	1	22.68	22.67	22.52	0	21.64	21.69	21.43	1
	3	3	22.66	22.67	22.6	0	21.58	21.69	21.54	1
	6	0	21.57	21.51	21.28	1	20.83	20.76	20.57	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 23025 700.5 MHz	CH 23095 707.5 MHz	CH 23165 714.5 MHz	3GPP MPR [dB]	CH 23025 700.5 MHz	CH 23095 707.5 MHz	CH 23165 714.5 MHz	3GPP MPR [dB]
12 / 3M	1	0	22.81	22.48	22.52	0	21.63	21.06	21.25	1
	1	7	22.47	22.6	22.5	0	21.59	21.57	21.28	1
	1	14	22.72	22.6	22.69	0	21.25	21.39	21.3	1
	8	0	21.73	21.67	21.61	1	20.7	20.52	20.6	2
	8	3	21.72	21.77	21.44	1	20.8	20.63	20.5	2
	8	7	21.82	21.8	21.42	1	20.71	20.73	20.49	2
	15	0	21.86	21.74	21.53	1	20.72	20.74	20.47	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 23035 701.5 MHz	CH 23095 707.5 MHz	CH 23155 713.5 MHz	3GPP MPR [dB]	CH 23035 701.5 MHz	CH 23095 707.5 MHz	CH 23155 713.5 MHz	3GPP MPR [dB]
12 / 5M	1	0	22.72	22.71	22.57	0	21.46	21.02	21.54	1
	1	12	22.88	23.15	22.71	0	21.56	21.75	21.35	1
	1	24	22.74	22.65	22.64	0	21.37	21.48	21.29	1
	12	0	21.89	21.65	21.79	1	20.73	20.43	20.39	2
	12	6	21.9	21.75	21.71	1	20.63	20.75	20.43	2
	12	13	21.89	21.75	21.57	1	20.59	20.83	20.25	2
	25	0	21.87	21.81	21.57	1	20.69	20.63	20.53	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 23060 704.0 MHz	CH 23095 707.5 MHz	CH 23130 711.0 MHz	3GPP MPR [dB]	CH 23060 704.0 MHz	CH 23095 707.5 MHz	CH 23130 711.0 MHz	3GPP MPR [dB]
12 / 10M	1	0	22.56	22.39	22.63	0	21.3	21.05	20.89	1
	1	24	22.69	22.7	22.9	0	21.12	21.55	21.76	1
	1	49	22.48	22.47	22.66	0	21.06	20.9	20.93	1
	25	0	21.47	21.58	21.83	1	20.6	20.57	20.7	2
	25	12	21.51	21.57	21.92	1	20.6	20.62	20.83	2
	25	25	21.52	21.35	21.77	1	20.7	20.54	20.54	2
	50	0	21.47	21.41	21.82	1	20.72	20.64	20.71	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 23205 779.5 MHz	CH 23230 782.0 MHz	CH 23255 784.5 MHz	3GPP MPR [dB]	CH 23205 779.5 MHz	CH 23230 782.0 MHz	CH 23255 784.5 MHz	3GPP MPR [dB]
13 / 5M	1	0	22.85	22.81	22.82	0	21.49	21.1	21.44	1
	1	12	22.99	22.76	23.25	0	21.62	21.52	21.99	1
	1	24	22.89	23.09	22.9	0	21.09	21.38	21.48	1
	12	0	21.94	21.92	22.02	1	20.74	20.71	20.79	2
	12	6	21.96	22.08	22.01	1	20.88	20.81	20.92	2
	12	13	21.89	22.01	22.03	1	20.7	20.9	21.01	2
	25	0	22.07	21.88	21.98	1	21.0	20.87	20.97	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			NA	CH 23230 782.0 MHz	NA	3GPP MPR [dB]	NA	CH 23230 782.0 MHz	NA	3GPP MPR [dB]
13 / 10M	1	0	22.37	22.37	22.37	0	21.32	21.32	21.32	1
	1	24	22.85	22.85	22.85	0	21.41	21.41	21.41	1
	1	49	22.78	22.78	22.78	0	21.45	21.45	21.45	1
	25	0	21.86	21.86	21.86	1	20.72	20.72	20.72	2
	25	12	21.92	21.92	21.92	1	20.78	20.78	20.78	2
	25	25	21.88	21.88	21.88	1	20.85	20.85	20.85	2
	50	0	21.9	21.9	21.9	1	20.86	20.86	20.86	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 131979 1710.7 MHz	CH 132322 1745.0 MHz	CH 132665 1779.3 MHz	3GPP MPR [dB]	CH 131979 1710.7 MHz	CH 132322 1745.0 MHz	CH 132665 1779.3 MHz	3GPP MPR [dB]
66 / 1.4M	1	0	23.82	23.76	20.36	0	22.48	22.19	20.17	1
	1	2	23.86	23.78	19.83	0	22.48	22.0	20.13	1
	1	5	23.78	23.53	20.02	0	22.2	22.09	19.38	1
	3	0	23.86	23.62	20.08	0	22.23	22.59	19.63	1
	3	1	23.81	23.68	19.58	0	22.26	22.57	19.69	1
	3	3	23.81	23.6	19.75	0	22.19	22.57	18.8	1
	6	0	22.79	22.66	20.47	1	21.14	21.72	19.27	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 131987 1711.5 MHz	CH 132322 1745.0 MHz	CH 132657 1778.5 MHz	3GPP MPR [dB]	CH 131987 1711.5 MHz	CH 132322 1745.0 MHz	CH 132657 1778.5 MHz	3GPP MPR [dB]
66 / 3M	1	0	23.21	23.32	19.01	0	22.42	22.18	19.08	1
	1	7	23.18	23.62	19.64	0	22.48	22.34	18.64	1
	1	14	22.94	23.61	18.84	0	22.36	22.27	18.15	1
	8	0	22.89	22.66	19.88	1	21.82	21.66	18.25	2
	8	3	22.79	22.68	19.57	1	21.8	21.59	18.18	2
	8	7	22.74	22.71	19.44	1	21.76	21.57	18.66	2
	15	0	22.73	22.62	19.79	1	21.96	21.69	18.98	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 131997 1712.5 MHz	CH 132322 1745.0 MHz	CH 132647 1777.5 MHz	3GPP MPR [dB]	CH 131997 1712.5 MHz	CH 132322 1745.0 MHz	CH 132647 1777.5 MHz	3GPP MPR [dB]
66 / 5M	1	0	22.95	22.88	19.65	0	22.48	22.06	18.67	1
	1	12	22.82	23.56	18.8	0	22.5	22.07	18.34	1
	1	24	22.6	23.69	18.44	0	22.06	22.09	18.65	1
	12	0	22.87	22.63	20.17	1	21.93	21.4	18.83	2
	12	6	22.84	22.67	19.89	1	21.92	21.56	18.58	2
	12	13	22.75	22.63	18.91	1	21.75	21.75	18.13	2
	25	0	22.85	22.55	19.31	1	21.86	21.6	19.34	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 132022 1715.0 MHz	CH 132322 1745.0 MHz	CH 132622 1775.0 MHz	3GPP MPR [dB]	CH 132022 1715.0 MHz	CH 132322 1745.0 MHz	CH 132622 1775.0 MHz	3GPP MPR [dB]
66 / 10M	1	0	22.26	20.73	19.16	0	21.93	20.29	18.83	1
	1	24	22.39	23.54	19.46	0	21.92	22.25	19.35	1
	1	49	19.89	22.69	18.16	0	19.43	22.4	17.67	1
	25	0	22.87	22.72	20.35	1	21.96	21.58	19.06	2
	25	12	22.73	22.76	19.76	1	21.84	21.71	17.27	2
	25	25	21.99	22.63	19.02	1	21.2	21.69	18.79	2
	50	0	22.09	22.51	19.87	1	21.74	21.56	19.09	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 132047 1717.5 MHz	CH 132322 1745.0 MHz	CH 132597 1772.5 MHz	3GPP MPR [dB]	CH 132047 1717.5 MHz	CH 132322 1745.0 MHz	CH 132597 1772.5 MHz	3GPP MPR [dB]
66 / 15M	1	0	22.0	21.56	20.38	0	21.44	20.09	20.22	1
	1	37	21.27	23.52	20.16	0	21.7	22.5	19.45	1
	1	74	19.61	22.97	15.67	0	18.51	22.43	18.38	1
	36	0	22.72	22.66	20.88	1	21.81	21.66	20.07	2
	36	19	22.23	22.66	20.79	1	20.87	21.67	20.02	2
	36	39	20.49	22.79	19.38	1	19.91	21.79	18.54	2
	75	0	22.05	22.53	19.64	1	21.4	21.67	20.04	2

LTE Band / BW	RBs	RB Start	QPSK				16QAM			
			CH 132072 1720.0 MHz	CH 132322 1745.0 MHz	CH 132572 1770.0 MHz	3GPP MPR [dB]	CH 132072 1720.0 MHz	CH 132322 1745.0 MHz	CH 132572 1770.0 MHz	3GPP MPR [dB]
66 / 20M	1	0	22.02	19.61	20.91	0	21.34	19.11	20.68	1
	1	50	21.18	23.61	20.64	0	20.85	22.61	20.39	1
	1	99	19.19	22.57	17.79	0	18.62	22.2	17.17	1
	50	0	22.53	22.54	20.11	1	21.23	21.18	20.88	2
	50	25	21.86	22.68	21.52	1	21.12	21.66	20.41	2
	50	50	21.17	22.68	19.68	1	18.75	21.74	19.03	2
	100	0	21.73	22.49	20.86	1	20.76	21.5	19.8	2

WLAN 2.4 GHz:

Standard	Transmission mode	Data rate [Mbps]	Output power [dBm]		
			CH 1 2412 MHz	CH 6 2437 MHz	CH 11 2462 MHz
802.11b	DSSS	1	14.63	14.78	14.9

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.

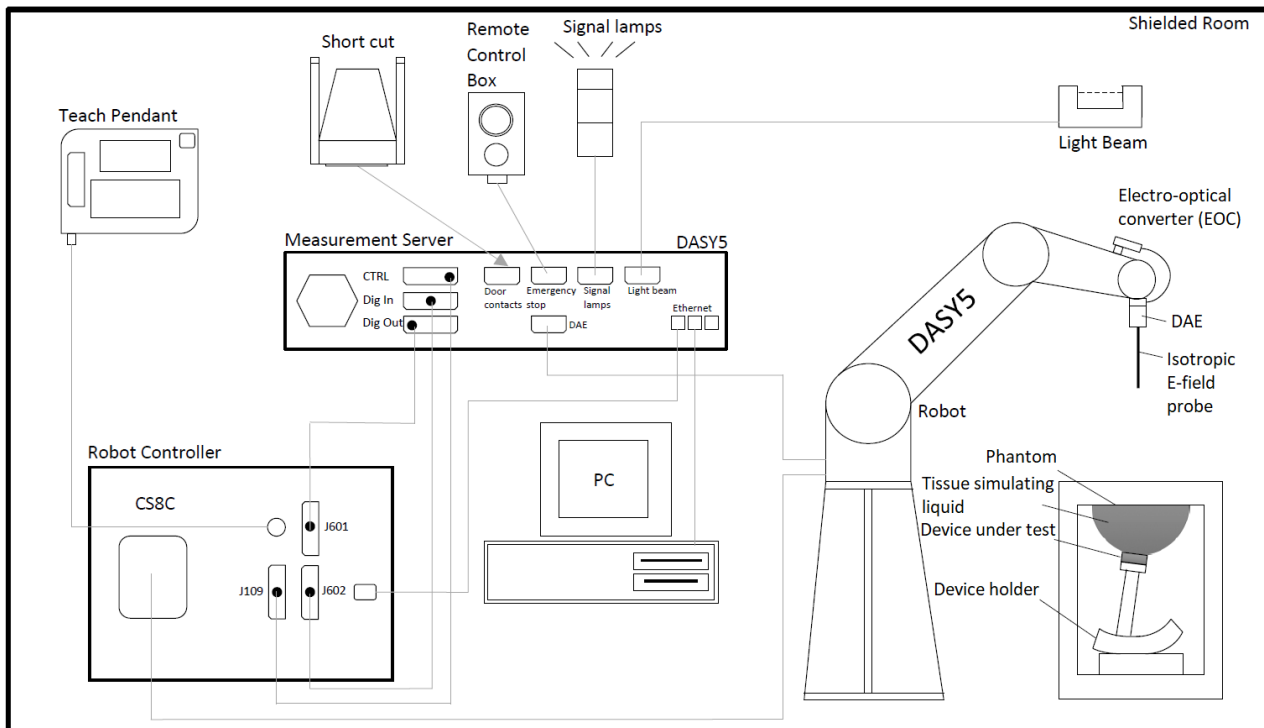


Figure 2 Schematic Laboratory Picture

4.1 Test Equipment List

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

Test Equipment	Model	Serial Number	Calibration Date
DASY5 Software	52.8.8.1258	-	NA
DAE4, converter	DAE4	710	10/2022
Isotropic DOS probe	EX3DV4	3892	04/2022
Isotropic DOS probe	EX3DV4	3852	10/2022
System validation dipole	D835V2	455	06/2022
System validation dipole	D1800V2	249	07/2022
System validation dipole	DIP 2G600	637	12/2021
System validation dipole	D750V3	1154	07/2022
System validation dipole	D1900V2	511	03/2020
System validation dipole	D2450V2	729	07/2022
Amplifier, 800MHz-4200MHz, 10W	10S1G4A	320421	NA
Radio Communication Analyzer	MT8820C	6200883099	10/2022
Vector Network Analyzer	E5071C	MY46102812	05/2022
Vector Network Analyzer	P5008A	MY58100258	01/2023
Inline Peak Power Sensor	MA24105A	2102058	11/2022
Vector Signal Generator	MG3710E	6262028676	NA

Dipole calibration period supporting data:

Dipole and serial number	Frequency (MHz)	Measured on 10/2022			Calibrated		
		Return loss (dB)	Impedance [Ω]		Return loss [dB]	Impedance [Ω]	
D1900V2 / 511	1900	-23.8	48.5	6.2	-21.37	52.9	8
DIP 2G600 / 637	2600	-28.3	46.4	-0.9	-31.57	51.4	2.3

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 μ W/g to > 100 mW/g, Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm Tip length: 10 mm Body diameter: 12 mm
Application	General dosimetry up to 6 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms

4.2 Phantoms

Eli Phantom:

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

4.3 Tissue Simulants

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

Tissue simulant liquid Ingredients
Deionized Water, oil, salt, emulsifiers

4.4 System Validation Status

Frequency [MHz]	Dipole Type / SN	Probe Type / SN	Calibrated Signal Type	DAE Unit / SN	Dielectric Constant [ϵ']	Conductivity σ [S/m]	Head tissue simulant
750	D750V3 / 635	EX3DV4 / 3892	CW	DAE 4 / 705	42.71	0.91	04/2022
835	D835V2 / 448	EX3DV4 / 3892	CW	DAE 4 / 705	42.47	0.94	05/2022
1800	D1800V2 / 2D075	EX3DV4 / 3892	CW	DAE 4 / 705	39.35	1.29	04/2022
2600	DIP 2G600 / 637	EX3DV4 / 3892	CW	DAE 4 / 705	38.89	1.81	04/2022
1800	D1800V2 / 249	EX3DV4 / 3852	CW	DAE 4 / 710	41.71	1.36	11/2022
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 #
01.03.2023	WB Head	22	835	250	2.47	9.69	9.88	1.96	1
06.03.2023	WB Head	22	835	250	2.38	9.69	9.52	-1.75	2
06.03.2023	WB Head	22	1800	250	9.18	38.9	36.72	-5.6	3
07.03.2023	WB Head	22	750	250	1.96	8.54	7.84	-8.20	4
07.03.2023	WB Head	22	2600	250	13.5	56.47	54	-4.37	5
08.03.2023	WB Head	22	1800	250	8.9	38.9	35.6	-8.5	6
08.03.2023	WB Head	22	1900	250	10.2	39.3	40.8	3.8	7
10.03.2023	WB Head	22	2450	250	12.5	52.3	50	-4.40	8

4.5.1 Tissue Simulant Verification

Date	Tissue Type	Tissue Temp [°C]	Frequency [MHz]	Target		Measured		Deviation	
				Dielectric Constant [ε] Target	Conductivity σ [S/m] Target	Dielectric Constant [ε]	Conductivity σ [S/m]	ε [%]	σ [%]
03.03.2023	WB Head	22	829.0	41.53	0.9	42.21	0.87	1.6	-3.7
03.03.2023	WB Head	22	835.0	41.5	0.9	42.19	0.87	1.7	-3.4
03.03.2023	WB Head	22	836.5	41.5	0.9	42.19	0.87	1.7	-3.4
03.03.2023	WB Head	22	844.0	41.5	0.91	42.17	0.87	1.6	-4.1
06.03.2023	WB Head	22	779.5	41.76	0.89	42.41	0.81	1.5	-9.5
06.03.2023	WB Head	22	782.0	41.75	0.89	42.4	0.81	1.5	-9.5
06.03.2023	WB Head	22	784.5	41.74	0.89	42.39	0.81	1.6	-9.4
06.03.2023	WB Head	22	826.4	41.54	0.9	42.3	0.82	1.8	-8.2
06.03.2023	WB Head	22	835.0	41.5	0.9	42.27	0.83	1.9	-8.0
06.03.2023	WB Head	22	836.6	41.5	0.9	42.26	0.83	1.8	-8.1
06.03.2023	WB Head	22	844.0	41.5	0.91	42.24	0.83	1.8	-8.6
07.03.2023	WB Head	22	704.0	42.15	0.89	40.47	0.84	-4.0	-5.2
07.03.2023	WB Head	22	707.5	42.13	0.89	40.47	0.84	-3.9	-5.1
07.03.2023	WB Head	22	711.0	42.11	0.89	40.46	0.84	-3.9	-5.0
07.03.2023	WB Head	22	750.0	41.9	0.89	40.34	0.85	-3.7	-4.2
07.03.2023	WB Head	22	2510.0	39.12	1.86	37.41	1.74	-4.4	-6.8
07.03.2023	WB Head	22	2535.0	39.09	1.89	37.42	1.75	-4.3	-7.2
07.03.2023	WB Head	22	2560.0	39.05	1.92	37.35	1.77	-4.4	-7.8
07.03.2023	WB Head	22	2600.0	39.0	1.96	37.27	1.8	-4.4	-8.1
08.03.2023	WB Head	22	1712.4	40.14	1.35	39.08	1.22	-2.6	-9.5
08.03.2023	WB Head	22	1720.0	40.13	1.35	39.06	1.23	-2.6	-9.5
08.03.2023	WB Head	22	1732.6	40.11	1.36	39.05	1.23	-2.6	-9.5
08.03.2023	WB Head	22	1745.0	40.09	1.37	39.03	1.24	-2.6	-9.5
08.03.2023	WB Head	22	1752.6	40.07	1.37	39.03	1.24	-2.6	-9.5
08.03.2023	WB Head	22	1770.0	40.05	1.38	39.01	1.25	-2.6	-9.5
08.03.2023	WB Head	22	1800.0	40.0	1.4	38.97	1.27	-2.6	-9.6
08.03.2023	WB Head	22	1852.4	40.0	1.4	38.91	1.29	-2.7	-7.5
08.03.2023	WB Head	22	1860.0	40.0	1.4	38.9	1.3	-2.7	-7.2
08.03.2023	WB Head	22	1880.0	40.0	1.4	38.88	1.31	-2.8	-6.5
08.03.2023	WB Head	22	1900.0	40.0	1.4	38.86	1.32	-2.9	-5.7
08.03.2023	WB Head	22	1907.6	40.0	1.4	38.85	1.33	-2.9	-5.4
10.03.2023	WB Head	22	2412.0	39.27	1.77	38.29	1.64	-2.5	-7.3
10.03.2023	WB Head	22	2437.0	39.22	1.79	38.26	1.65	-2.5	-7.7
10.03.2023	WB Head	22	2450.0	39.2	1.8	38.22	1.66	-2.5	-7.8
10.03.2023	WB Head	22	2462.0	39.18	1.81	38.18	1.67	-2.6	-8.0

5. TEST PROCEDURE

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

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

For the cellular technologies, the device was set to transmit using maximum power with a communication tester.

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

The WLAN transmission modes for testing were selected according to largest channel bandwidth configuration, lowest order modulation and lowest data rate.

WLAN 2.4GHz was tested with 802.11b standard with data rate of 1Mbit/s.

5.1 Test Positions

5.1.1 Body-worn Configuration, 0mm separation distance

Body SAR was tested from the user's side, which would be pressed against the user's back. The device was placed on the top of a Rohacell and lifted towards the phantom until the distance between phantom and the device was 0mm.

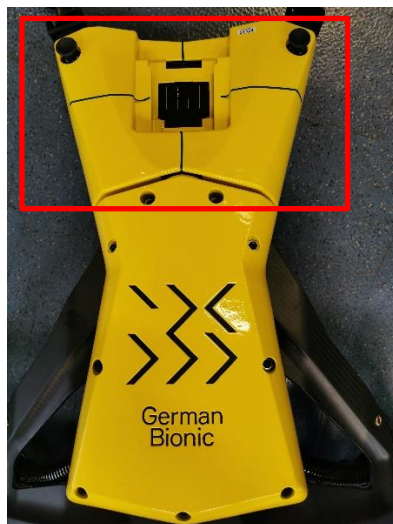


Figure 3. Location of the antennas

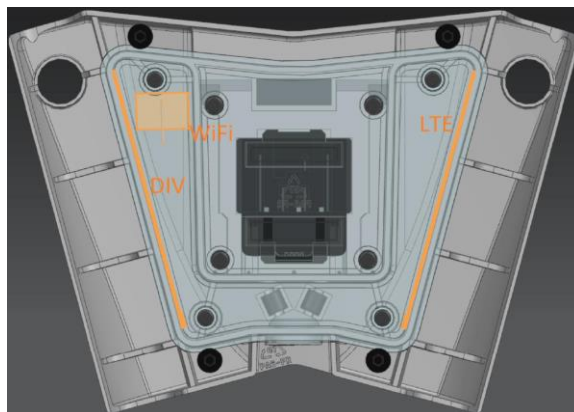


Figure 4. Schematic of the antennas

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.

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.

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.	(c) 1g	(c) 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 _{sys}	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 _a)	Conductivity (temp.) ^{BB}	±3.3%	R	√3	0.78	0.71	±1.5%	±1.4%
EPS	Phantom Permittivity	±14.0%	R	3	0	0	±0%	±0%
DIS	Distance DUT - TSL	±2.0%	N	1	2	2	±4.0%	±4.0%
D _{xyz}	Device Positioning (±0.5mm)	±1.0%	N	1	1	1	±1.0%	±1.0%
H	Device Holder	±3.6%	N	√1	1	1	±3.6%	±3.6%
MOD	DUT Modulation ^m	±2.4%	R	√3	1	1	±1.4%	±1.4%
TAS	Time-average SAR	±2.6%	R	3	1	1	±1.5%	±1.5%
RF _{drift}	DUT drift	±2.5%	N	1	1	1	±2.5%	±2.5%
VAL	Val Antenna Unc. ^{val}	±0.0%	N	1	1	1	±0%	±0%
RF _{in}	Unc. Input Power ^{val}	±0.0%	N	1	1	1	±0%	±0%
Correction to the SAR results								
C(ε, σ)	Deviation to Target	±1.9%	N	√1	1	0.84	±1.9%	±1.6%
C(R)	SAR scaling ^p	±0%	R	3	1	1	±0%	±0%
u(ΔSAR)	Combined Uncertainty						±11.0%	±10.9%
U	Expanded Uncertainty						±22.1%	±21.9%

7. TEST RESULTS

7.1 SAR Results for Body Exposure Condition with 0mm separation

WCDMA:

Band	Channel	Frequency [MHz]	Mode	Maximum Power [dBm]	Conducted Power [dBm]	Test Position	Measured SAR _{1g} [W/kg]	Power Drift** [dB]	Duty Cycle	Scaling Factor	Reported SAR _{1g} [W/kg]	Plot #
WCDMA 2	9262	1852.4	RMC 12.2K	25	24.46	Front, 0mm	0*	0	1.13	1:1	0.00	
WCDMA 2	9400	1880	RMC 12.2K	25	24.53	Front, 0mm	0.0000038	0	1.11	1:1	0.0000042	
WCDMA 2	9538	1907.6	RMC 12.2K	25	24.64	Front, 0mm	0.000017	0	1.09	1:1	0.000019	9

*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.

Band	Channel	Frequency [MHz]	Mode	Maximum Power [dBm]	Conducted Power [dBm]	Test Position	Measured SAR _{1g} [W/kg]	Power Drift** [dB]	Duty Cycle	Scaling Factor	Reported SAR _{1g} [W/kg]	Plot #
WCDMA 4	1312	1712.4	RMC 12.2K	25	23.9	Front, 0mm	0*	0	1.29	1:1	0.00	
WCDMA 4	1413	1732.6	RMC 12.2K	25	22.16	Front, 0mm	0.000000498	0	1.92	1:1	0.0000010	10
WCDMA 4	1513	1752.6	RMC 12.2K	25	23.51	Front, 0mm	0.00000091	0	1.41	1:1	0.0000013	

*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.

Band	Channel	Frequency [MHz]	Mode	Maximum Power [dBm]	Conducted Power [dBm]	Test Position	Measured SAR _{1g} [W/kg]	Power Drift* [dB]	Duty Cycle	Scaling Factor	Reported SAR _{1g} [W/kg]	Plot #
WCDMA 5	4132	826.4	RMC 12.2K	25	23.47	Front, 0mm	0.0012	-0.72	1.68	1:1	0.0020	
WCDMA 5	4183	835	RMC 12.2K	25	23.26	Front, 0mm	0.00036	-0.33	1.61	1:1	0.00058	
WCDMA 5	4233	846.6	RMC 12.2K	25	23.3	Front, 0mm	0.0020	-0.08	1.48	1:1	0.0030	11

*Larger than 5% drifts included to scaling factors

LTE:

Band	Channel	Frequency [MHz]	Modulation / BW [MHz]	RB Size	RB Offset	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measure SAR _{1g} [W/kg]	Power Drift* [dB]	Scaling Factor	Duty Cycle	Reported SAR _{1g} [W/kg]	Plot #
LTE 2	18700	1860	QPSK/20	1	0	25.7	23.01	Front, 0mm	0.0000021	0	1.86	1:1	0.0000039	
LTE 2	18700	1860	QPSK/20	50	0	25.7	22.03	Front, 0mm	0.00071**	0	2.33	1:1	0.0016	12
LTE 2	18900	1880	QPSK/20	1	50	25.7	22.71	Front, 0mm	0.00077	0	1.99	1:1	0.0015	
LTE 2	19100	1900	QPSK/20	1	50	25.7	22.88	Front, 0mm	0.000095	0	1.91	1:1	0.00018	

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

**Reported SAR value is based on area scan measurement. Zoom scan evaluations failed due to low e-field generated by the DUT.

Band	Channel	Frequency [MHz]	Modulation / BW [MHz]	RB Size	RB Offset	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measure SAR _{1g} [W/kg]	Power Drift* [dB]	Scaling Factor	Duty Cycle	Reported SAR _{1g} [W/kg]	Plot #
LTE 5	20450	829	QPSK/10	1	24	25.7	23.55	Front, 0mm	0.0034	0.45	1.82	1:1	0.0062	13
LTE 5	20450	829	QPSK/10	25	12	25.7	22.33	Front, 0mm	0.00014	0.12	2.17	1:1	0.00031	
LTE 5	20525	836.5	QPSK/10	1	0	25.7	23.14	Front, 0mm	0.00050	-0.55	2.05	1:1	0.0010	
LTE 5	20600	844	QPSK/10	1	49	25.7	23.08	Front, 0mm	0.0000029	-0.05	1.83	1:1	0.000053	

*Larger than 5% drifts included to scaling factors

Band	Channel	Frequency [MHz]	Modulation / BW [MHz]	RB Size	RB Offset	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measure SAR _{1α} [W/kg]	Power Drift* [dB]	Scaling Factor	Duty Cycle	Reported SAR _{1α} [W/kg]	Plot #
LTE 7	21350	2560	QPSK/20	1	50	25.7	25.55	Front, 0mm	0.00404**	0.83	1.25	1:1	0.0051	14
LTE 7	21350	2560	QPSK/20	50	0	25.7	24.51	Front, 0mm	0.000899	0.28	1.40	1:1	0.0013	
LTE 7	20850	2510	QPSK/20	1	50	25.7	24.98	Front, 0mm	0.00000391	0.8	1.42	1:1	0.0000055	
LTE 7	21100	2535	QPSK/20	1	50	25.7	25.31	Front, 0mm	0.000156	-0.61	1.26	1:1	0.00020	

*Larger than 5% drifts included to scaling factors

**Reported SAR value is based on area scan measurement. Zoom scan evaluations failed due to low e-field generated by the DUT.

Band	Channel	Frequency [MHz]	Modulation / BW [MHz]	RB Size	RB Offset	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measure SAR _{1α} [W/kg]	Power Drift* [dB]	Scaling Factor	Duty Cycle	Reported SAR _{1α} [W/kg]	Plot #
LTE 12	23130	711	QPSK/10	1	24	25.7	22.9	Front, 0mm	0.0041**	-0.27	2.03	1:1	0.0083	15
LTE 12	23130	711	QPSK/10	25	12	25.7	21.92	Front, 0mm	0.00000257	-0.48	2.67	1:1	0.0000069	
LTE 12	23060	704	QPSK/10	1	24	25.7	22.69	Front, 0mm	0.00000187	-0.59	2.29	1:1	0.0000043	
LTE 12	23095	707.5	QPSK/10	1	24	25.7	22.7	Front, 0mm	0.00000649	0.85	2.43	1:1	0.000016	

*Larger than 5% drifts included to scaling factors

**Reported SAR value is based on area scan measurement. Zoom scan evaluations failed due to low e-field generated by the DUT.

Band	Channel	Frequency [MHz]	Modulation / BW [MHz]	RB Size	RB Offset	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measure SAR _{1α} [W/kg]	Power Drift* [dB]	Scaling Factor	Duty Cycle	Reported SAR _{1α} [W/kg]	Plot #
LTE 13	23230	782	QPSK/10	1	24	25.7	22.85	Front, 0mm	0.00765	-0.26	2.05	1:1	0.016	
LTE 13	23230	782	QPSK/10	25	12	25.7	21.92	Front, 0mm	0.00749	-0.59	2.74	1:1	0.020	16
LTE 13	23205	779.5	QPSK/5	1	12	25.7	22.99	Front, 0mm	0.00753	-0.79	2.24	1:1	0.017	
LTE 13	23255	784.5	QPSK/5	1	12	25.7	23.25	Front, 0mm	0.00734	-0.15	1.76	1:1	0.013	

*Larger than 5% drifts included to scaling factors

Band	Channel	Frequency [MHz]	Modulation / BW [MHz]	RB Size	RB Offset	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measure SAR _{1α} [W/kg]	Power Drift** [dB]	Scaling Factor	Duty Cycle	Reported SAR _{1α} [W/kg]	Plot #
LTE 66	132322	1745	QPSK/20	1	50	25.7	23.61	Front, 0mm	0.00000139	0	1.62	1:1	0.0000022	
LTE 66	132322	1745	QPSK/20	50	25	25.7	22.68	Front, 0mm	0.00000413	0	2.00	1:1	0.0000083	
LTE 66	132072	1720	QPSK/20	1	0	25.7	22.02	Front, 0mm	0*	0	1.0	1:1	0	
LTE 66	132572	1770	QPSK/20	1	0	25.7	20.91	Front, 0mm	0.00000434	0	3.01	1:1	0.000013	17

*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.

2.4GHz WLAN:

Mode	Data Rate [Mbps]	Frequency [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR _{1g} [W/kg]	Power Drift** [dB]	Scaling Factor	Duty Cycle [%]	Reported SAR _{1α} [W/kg]	Plot #
802.11b	1	2412	1	Front, 0mm	17	14.72	0.000000000134	0	1.69	100	0.000000002	18
802.11b	1	2437	6	Front, 0mm	17	14.92	0*	0	1.61	100	0	
802.11b	1	2462	11	Front, 0mm	17	14.97	0*	0	1.60	100	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.

7.2 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.

7.3 Simultaneous Transmission Analysis

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

Body SAR:

Exposure Condition		Body SAR _{1a} [W/kg]
Test Position		Front
Cellular	WCDMA 2	0.000019
	WCDMA 4	0.0000010
	WCDMA 5	0.0030
	LTE 2	0.0016
	LTE 5	0.0062
	LTE 7	0.0051
	LTE 12	0.0083
	LTE 13	0.020
	LTE 66	0.000013
Maximum Cellular SAR		0.02
Maximum 2.4 GHz WLAN SAR		0.000000002
SAR Summation:		0.02

APPENDIX A: PHOTOS OF THE DUT



Figure 5. Front side, 0mm

APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 01/03/2023 15:18:36

Test Laboratory: Verkotan Oy

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:455

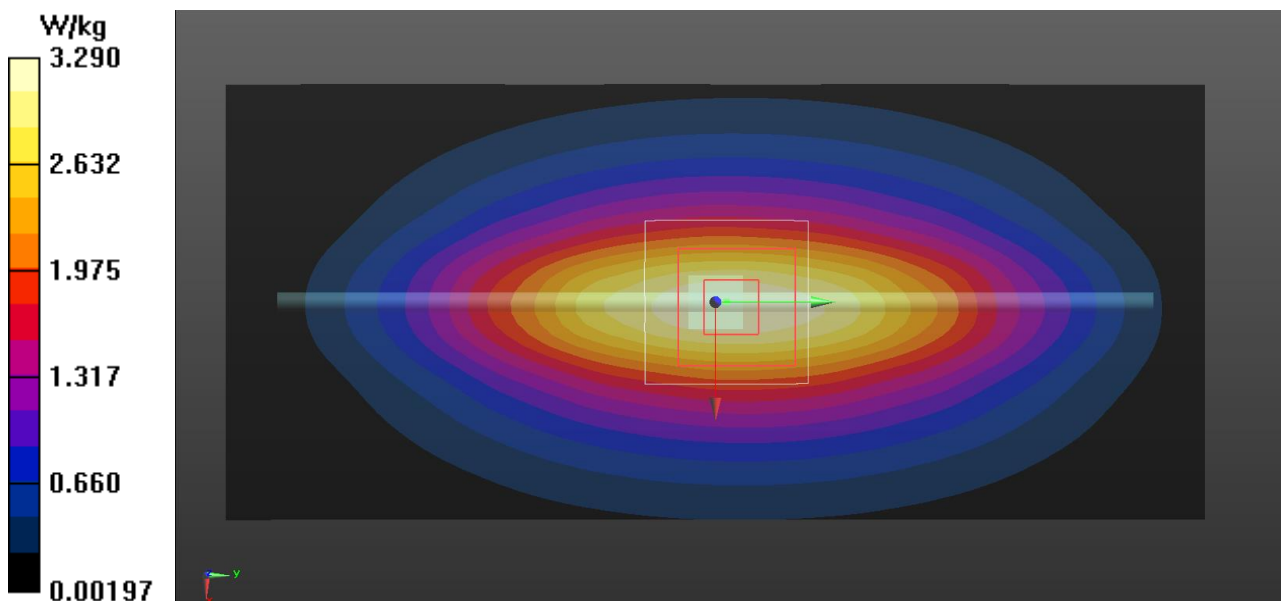
Communication System: UID 0, CW (0); Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 835$ MHz; $\sigma = 0.896$ S/m; $\epsilon_r = 43.114$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.95, 9.95, 9.95) @ 835 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0$, -4.0
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASYS2 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 835MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 56.33 V/m; Power Drift = -0.37 dB
Peak SAR (extrapolated) = 3.68 W/kg
SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.62 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 3.26 W/kg

Configuration/System check, 835MHz/Area Scan (41x91x1): Interpolated grid: $dx=2.000$ mm, $dy=2.000$ mm
Maximum value of SAR (interpolated) = 3.29 W/kg



Plot 2

Date/Time: 06/03/2023 9.21.44

Test Laboratory: Verkotan Oy

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:455

Communication System: UID 0, CW (0); Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.828 \text{ S/m}$; $\epsilon_r = 42.271$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.95, 9.95, 9.95) @ 835 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0, -4.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 835MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 53.81 V/m; Power Drift = -0.03 dB

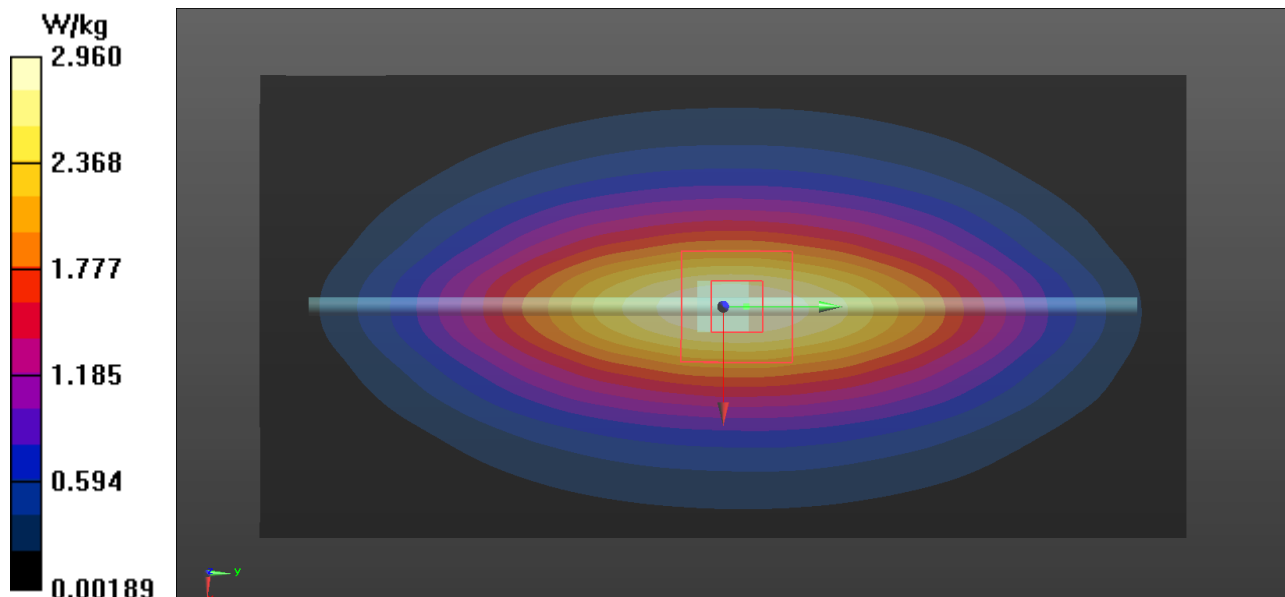
Peak SAR (extrapolated) = 3.33 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.55 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 2.96 W/kg

Configuration/System check, 835MHz/Area Scan (61x121x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 2.96 W/kg



Plot 3

Date/Time: 06/03/2023 10:39:30

Test Laboratory: Verkotan Oy

DUT: Dipole 1800 MHz D1800V2; Type: D1800V2; Serial: D1800V2 - SN:249

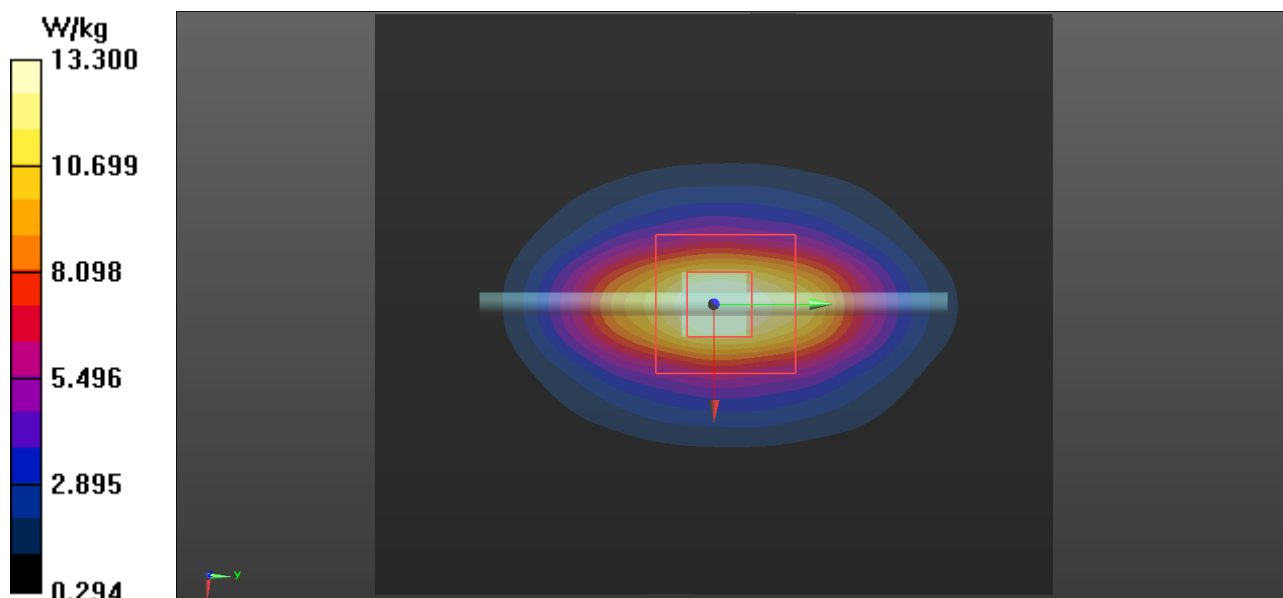
Communication System: UID 0, CW (0); Communication System Band: D1800 (1800.0 MHz); Frequency: 1800 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 1800$ MHz; $\sigma = 1.287$ S/m; $\epsilon_r = 40.44$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.31, 8.31, 8.31) @ 1800 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 1800MHz/Area Scan (61x71x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 14.3 W/kg

Configuration/System check, 1800MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 88.52 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 15.7 W/kg
SAR(1 g) = 9.18 W/kg; SAR(10 g) = 4.83 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 13.3 W/kg



Plot 4

Date/Time: 07/03/2023 13.32.40

Test Laboratory: Verkotan Oy

DUT: D750V3 - SN1154; Type: D750V3; Serial: SN1154

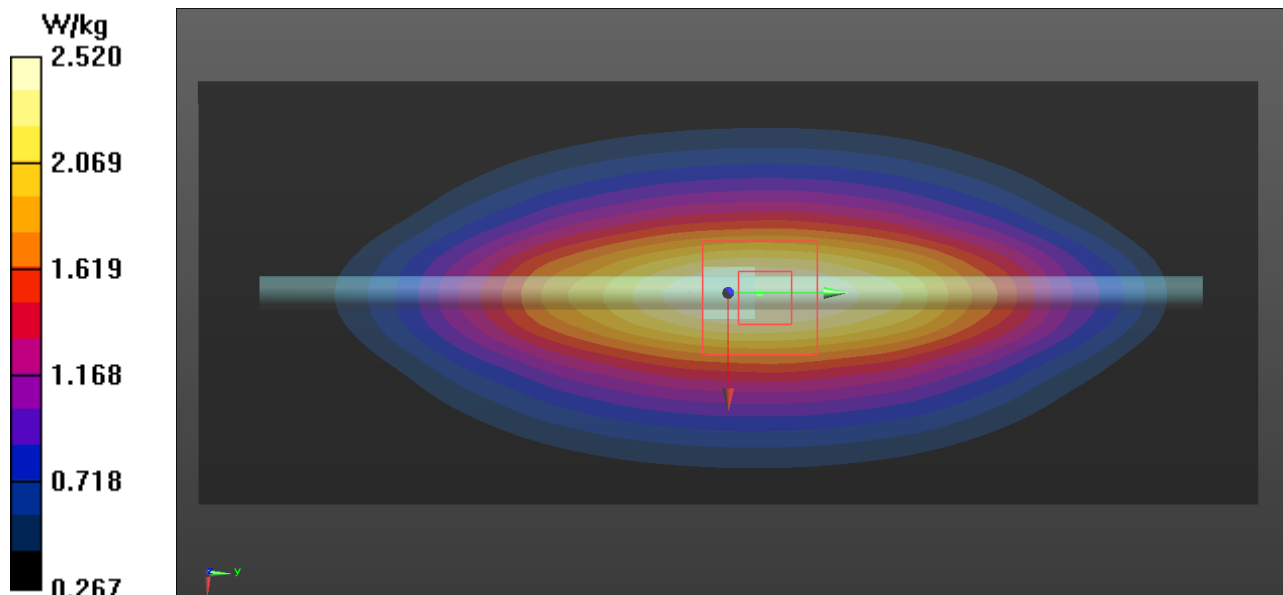
Communication System: UID 0, CW (0); Communication System Band: D750 (750.0 MHz); Frequency: 750 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 750$ MHz; $\sigma = 0.853$ S/m; $\epsilon_r = 40.338$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(10.26, 10.26, 10.26) @ 750 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 750MHz/Area Scan (41x101x1): Interpolated grid: $dx=2.000$ mm, $dy=2.000$ mm
Maximum value of SAR (interpolated) = 2.60 W/kg

Configuration/System check, 750MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 51.05 V/m; Power Drift = -0.34 dB
Peak SAR (extrapolated) = 2.81 W/kg
SAR(1 g) = 1.96 W/kg; SAR(10 g) = 1.31 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 2.52 W/kg



Plot 5

Date/Time: 07/03/2023 13.06.56

Test Laboratory: Verkotan Oy

DUT: Dipole 2600 MHz D2600V2; Type: D2600V2; Serial: D2600V2 - SN: 49/21 DIP2G600-637

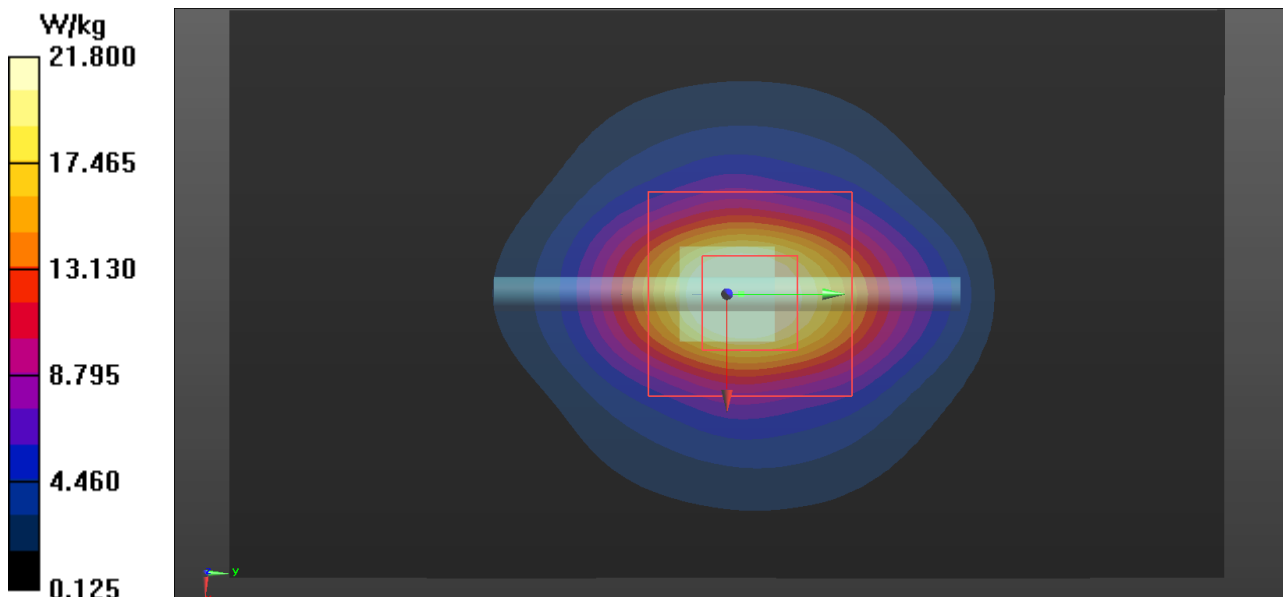
Communication System: UID 0, CW (0); Communication System Band: D2600 (2600.0 MHz); Frequency: 2600 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 2600$ MHz; $\sigma = 1.801$ S/m; $\epsilon_r = 37.269$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.55, 7.55, 7.55) @ 2600 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 2600MHz/Area Scan (41x71x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 25.0 W/kg

Configuration/System check, 2600MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 90.12 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.06 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 21.8 W/kg



Plot 6

Date/Time: 08/03/2023 16.27.29

Test Laboratory: Verkotan Oy

DUT: Dipole 1800 MHz D1800V2; Type: D1800V2; Serial: D1800V2 - SN:249

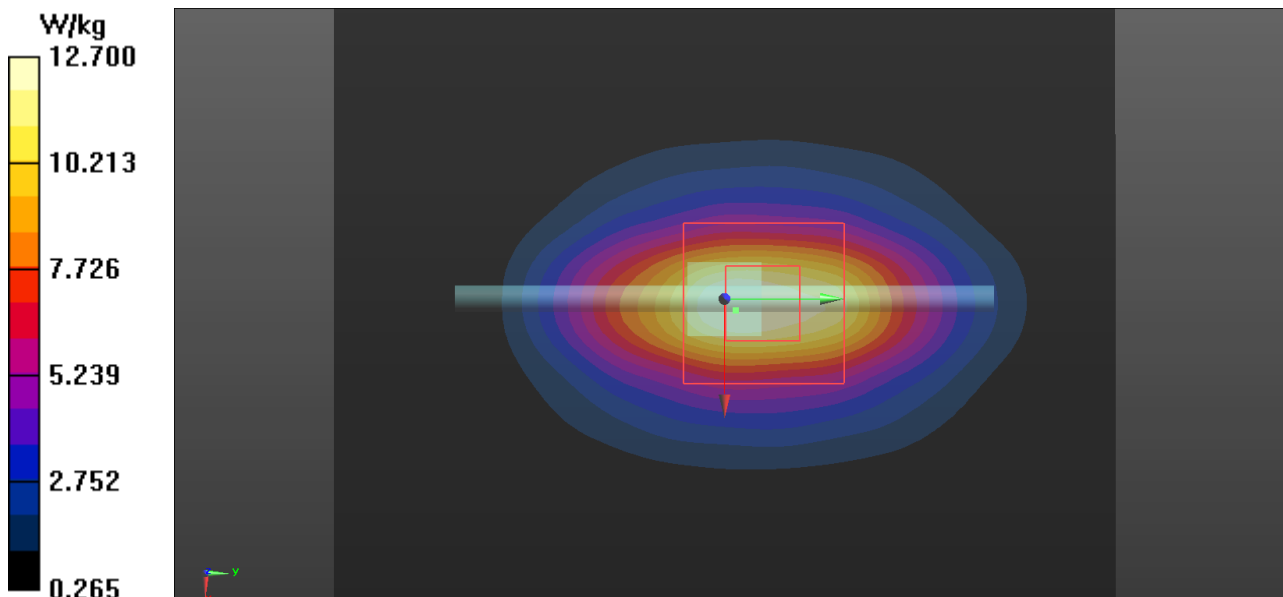
Communication System: UID 0, CW (0); Communication System Band: D1800 (1800.0 MHz); Frequency: 1800 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 1800$ MHz; $\sigma = 1.266$ S/m; $\epsilon_r = 38.966$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.9, 7.9, 7.9) @ 1800 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: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 1800MHz/Area Scan (61x71x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 13.1 W/kg

Configuration/System check, 1800MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 85.38 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 15.0 W/kg
SAR(1 g) = 9 W/kg; SAR(10 g) = 4.75 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 12.7 W/kg



Plot 7

Date/Time: 08/03/2023 17.05.32

Test Laboratory: Verkotan Oy

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

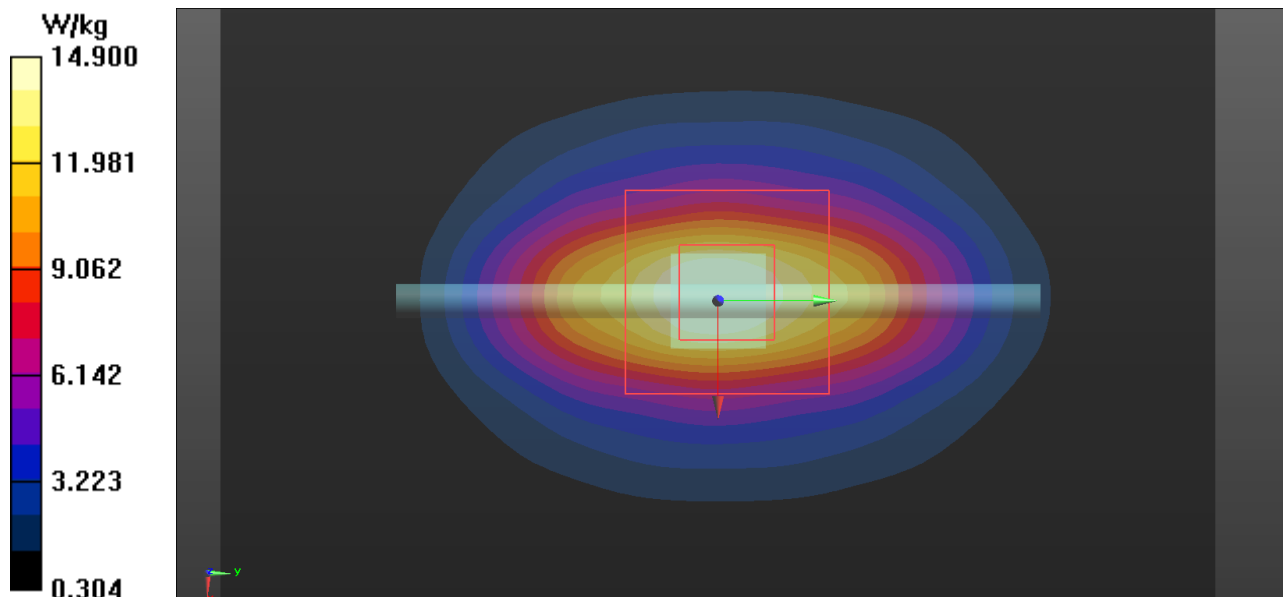
Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 1900$ MHz; $\sigma = 1.321$ S/m; $\epsilon_r = 38.858$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

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), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 1900MHz/Area Scan (61x71x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 16.0 W/kg

Configuration/System check, 1900MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 91.75 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.35 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 14.9 W/kg



Plot 8

Date/Time: 10/03/2023 11.07.10

Test Laboratory: Verkotan Oy

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

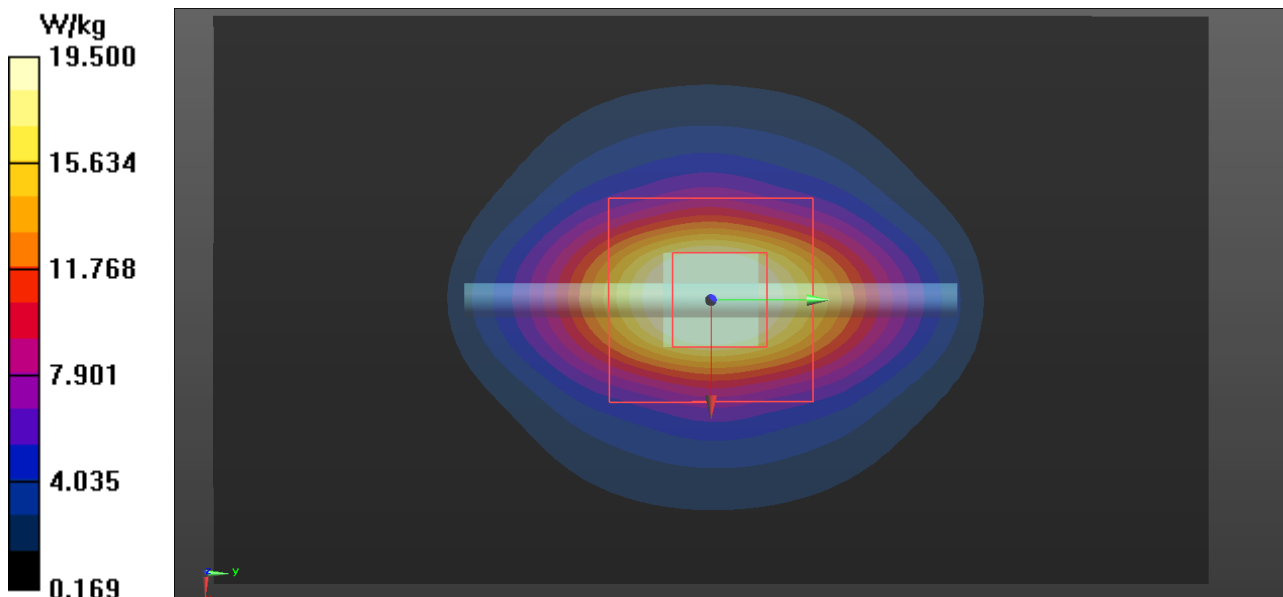
Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.659$ S/m; $\epsilon_r = 38.221$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

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), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/System check, 2450MHz/Area Scan (41x71x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 23.7 W/kg

Configuration/System check, 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 120.6 V/m; Power Drift = -0.54 dB
Peak SAR (extrapolated) = 23.5 W/kg
SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.86 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 19.5 W/kg



APPENDIX C: MEASUREMENT SCANS

Plot 9

Date/Time: 09/03/2023 17.26.07

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

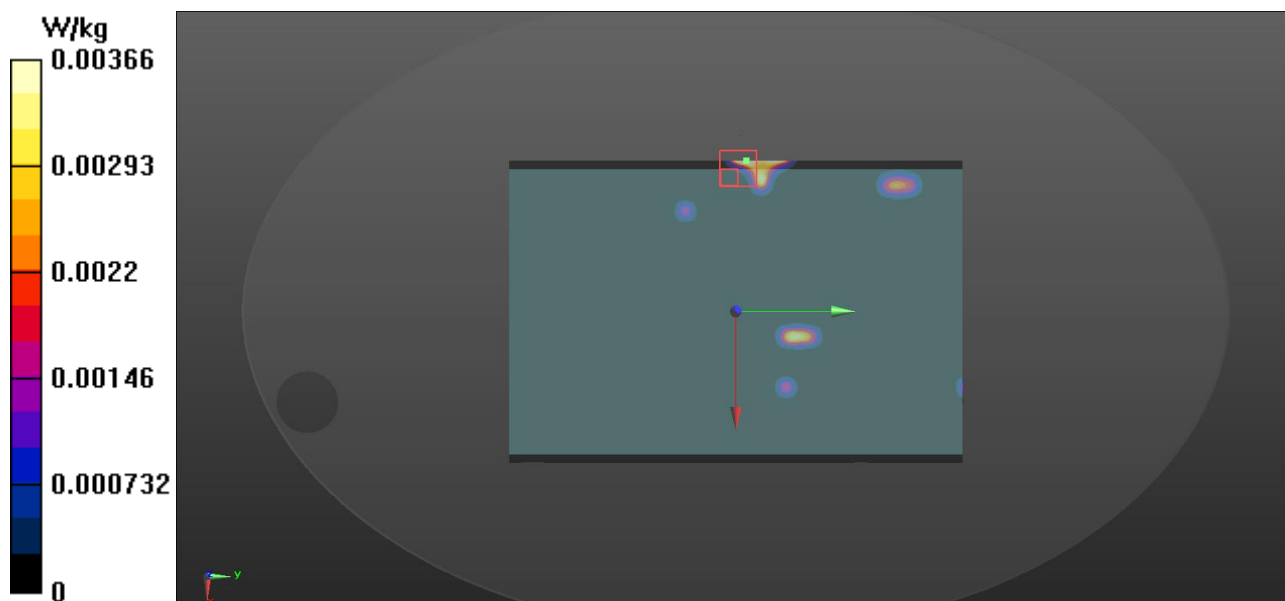
Communication System: UID 0, WCDMA (0); Communication System Band: Band 2; Frequency: 1907.6 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 1908$ MHz; $\sigma = 1.325$ S/m; $\epsilon_r = 38.846$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.72, 7.72, 7.72) @ 1907.6 MHz; Calibrated: 27/10/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/CrayGen5, WCDMA 2, RMC 12.2K, CH9538/Area Scan (121x181x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 0.00800 W/kg

Configuration/CrayGen5, WCDMA 2, RMC 12.2K, CH9538/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 0.9100 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.00380 W/kg
SAR(1 g) = 1.74e-005 W/kg; SAR(10 g) = 3.12e-006 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00366 W/kg



Plot 10

Date/Time: 10/03/2023 8.48.20

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

Communication System: UID 0, WCDMA (0); Communication System Band: Band 4; Frequency: 1732.6 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 1733$ MHz; $\sigma = 1.232$ S/m; $\epsilon_r = 39.048$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.9, 7.9, 7.9) @ 1732.6 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: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASYS2 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/CrayGen5, WCDMA 4, RMC 12.2K, CH1413/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 0.2840 V/m; Power Drift = 9.60 dB

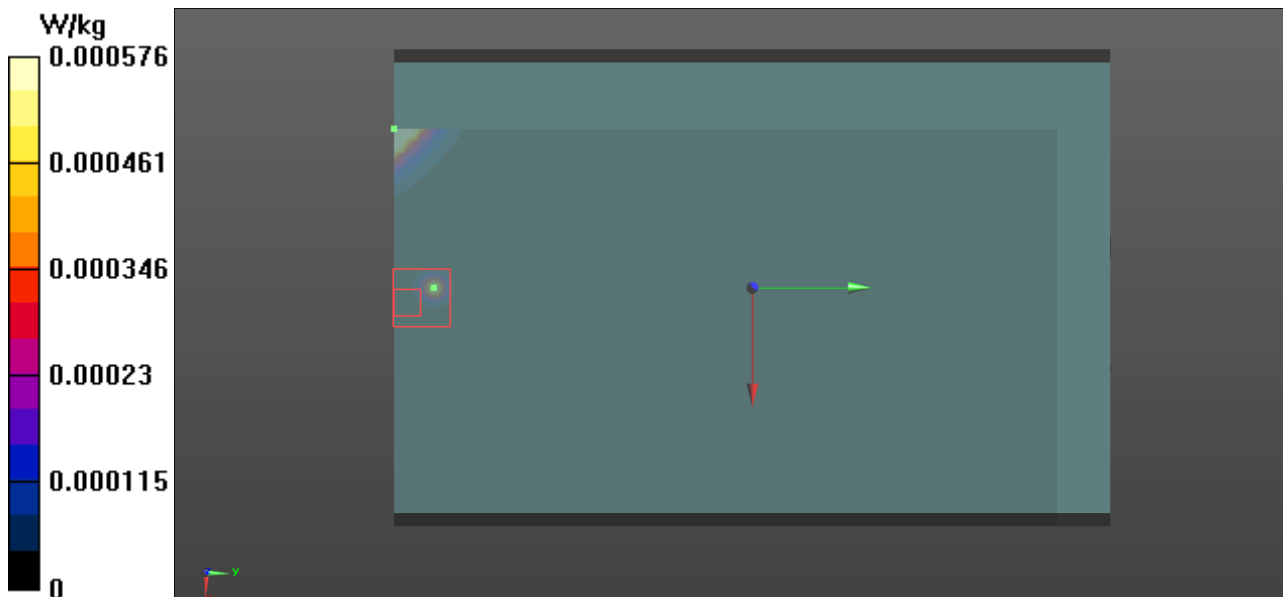
Peak SAR (extrapolated) = 0.000390 W/kg

SAR(1 g) = 4.98e-006 W/kg; SAR(10 g) = 6.73e-007 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.00140 W/kg

Configuration/CrayGen5, WCDMA 4, RMC 12.2K, CH1413/Area Scan (121x181x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 0.000576 W/kg



Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

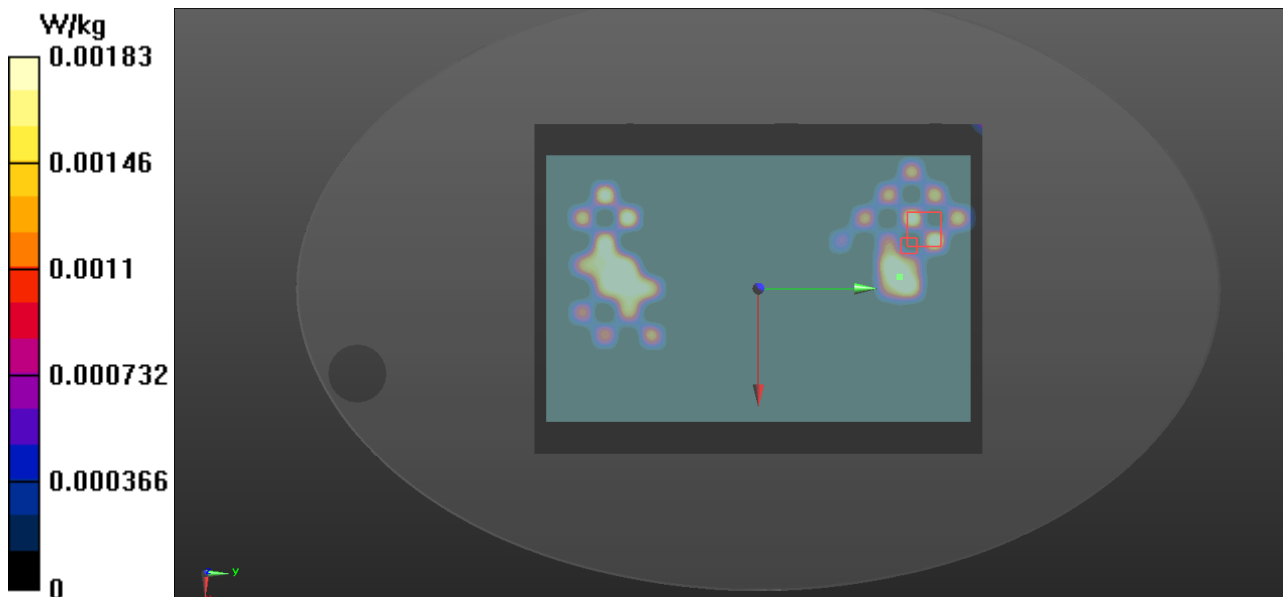
Communication System: UID 0, WCDMA (0); Communication System Band: Band 5; Frequency: 846.6 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 847$ MHz; $\sigma = 0.833$ S/m; $\epsilon_r = 42.231$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.95, 9.95, 9.95) @ 846.6 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/CrayGen5, WCDMA5, RMC 12.2k, CH4233/Area Scan (141x191x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 0.00256 W/kg

Configuration/CrayGen5, WCDMA5, RMC 12.2k, CH4233/Zoom Scan (14x14x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 1.889 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.00830 W/kg
SAR(1 g) = 0.00201 W/kg; SAR(10 g) = 0.00115 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00325 W/kg



Plot 12

Date/Time: 09/03/2023 13.49.44

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

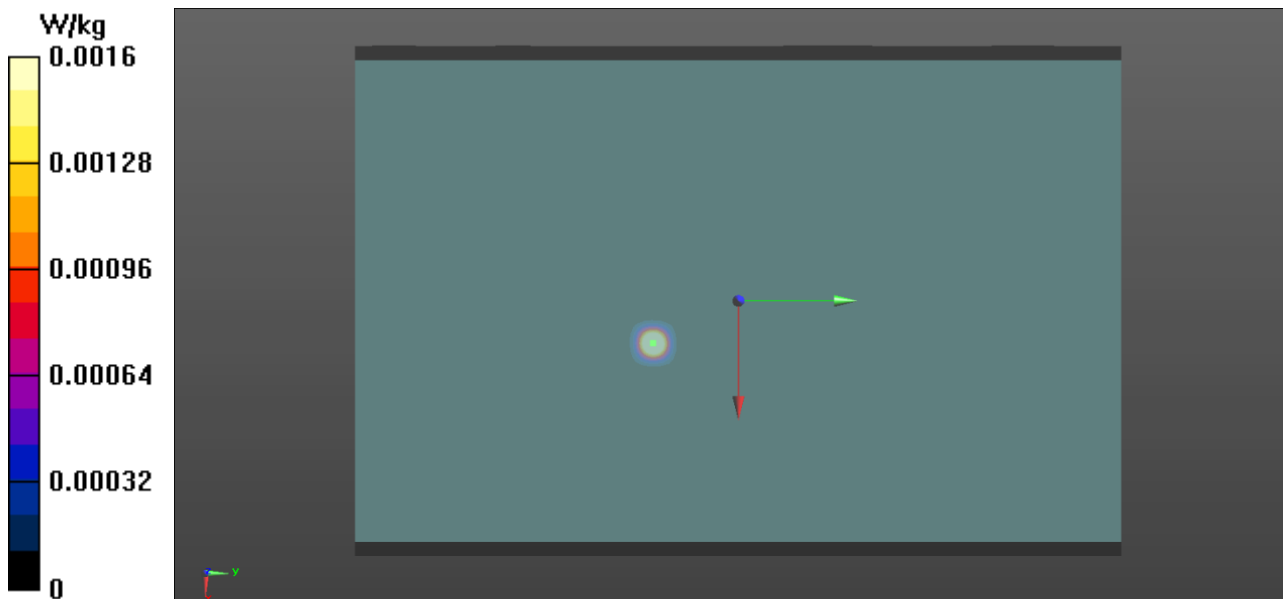
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 2, E-UTRA/FDD (1850.0 - 1910.0 MHz); Frequency: 1860 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 1860$ MHz; $\sigma = 1.299$ S/m; $\epsilon_r = 38.904$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.72, 7.72, 7.72) @ 1860 MHz; Calibrated: 27/10/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASYS2 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/CrayGen5, LTE2, BW20, RBs 50, Offset 0, CH18700/Area Scan (121x181x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 0.00291 W/kg

Configuration/CrayGen5, LTE2, BW20, RBs 50, Offset 0, CH18700/Zoom Scan (10x10x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 0.8580 V/m; Power Drift = -4.96 dB
Peak SAR (extrapolated) = 0 W/kg
SAR(1 g) = n.a. ; SAR(10 g) = n.a. (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00160 W/kg



Plot 13

Date/Time: 03/03/2023 11.36.51

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

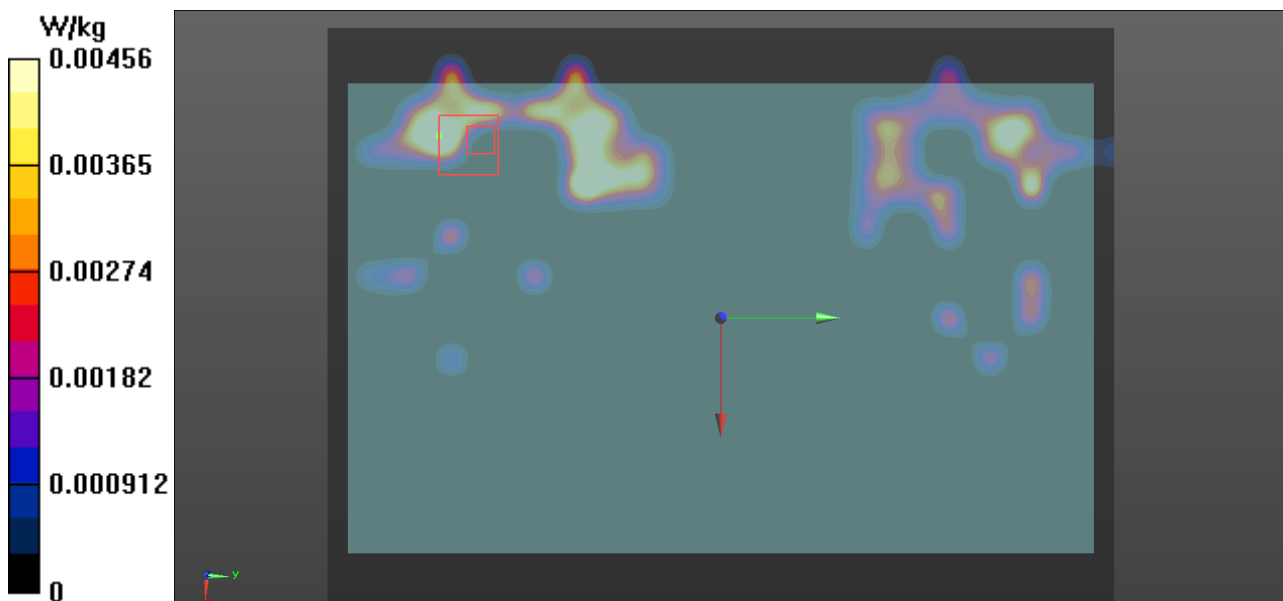
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 5, E-UTRA/FDD (824.0 - 849.0 MHz); Frequency: 829 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 829$ MHz; $\sigma = 0.866$ S/m; $\epsilon_r = 42.209$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.95, 9.95, 9.95) @ 829 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/CrayGen5, LTE5, BW10, RBs 1, Offset 24, CH20450/Area Scan (141x191x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 0.0117 W/kg

Configuration/CrayGen5, LTE5, BW10, RBs 1, Offset 24, CH20450/Zoom Scan (8x9x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 1.855 V/m; Power Drift = 0.45 dB
Peak SAR (extrapolated) = 0.00531 W/kg
SAR(1 g) = 0.00342 W/kg; SAR(10 g) = 0.00162 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00456 W/kg



Plot 14

Date/Time: 08/03/2023 15:12:52

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5

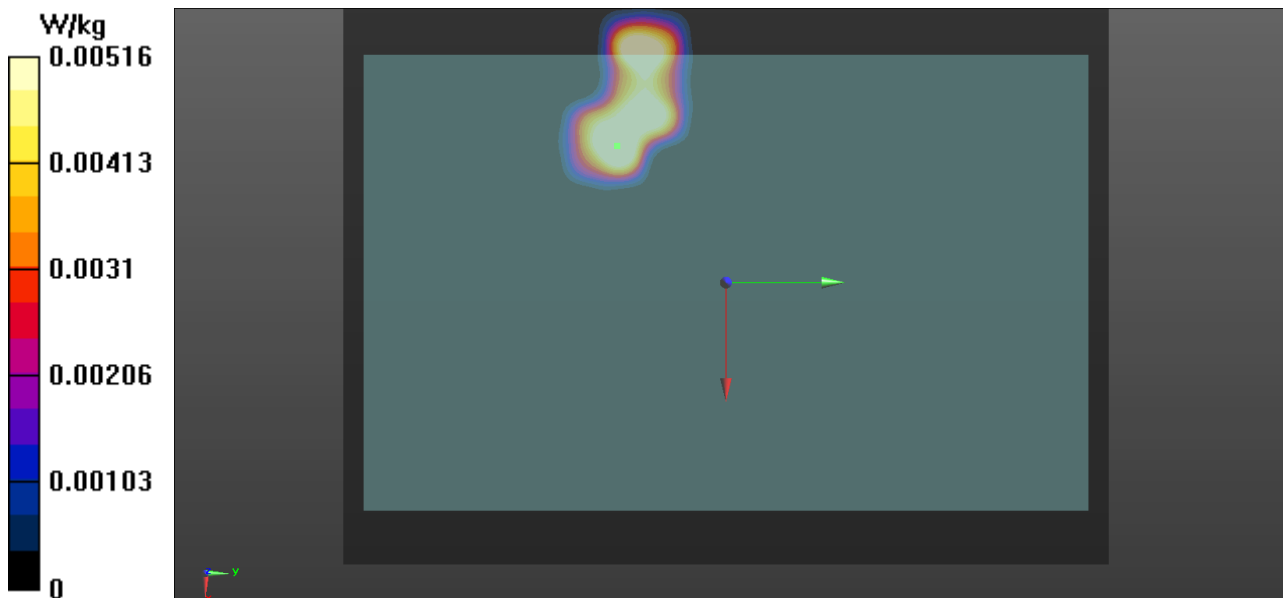
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 7, E-UTRA/FDD (2500.0 - 2570.0 MHz); Frequency: 2560 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 2560$ MHz; $\sigma = 1.768$ S/m; $\epsilon_r = 37.354$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(7.55, 7.55, 7.55) @ 2560 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELL; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/CrayGen5, LTE7 BW20, QPSK, RBs 1, Offset 50, CH21350/Area Scan (141x191x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 0.00668 W/kg

Configuration/CrayGen5, LTE7 BW20, QPSK, RBs 1, Offset 50, CH21350/Zoom Scan (10x12x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 1.098 V/m; Power Drift = 0.83 dB
Peak SAR (extrapolated) = 0 W/kg
SAR(1 g) = n.a.; SAR(10 g) = n.a. (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00516 W/kg



Plot 15

Date/Time: 07/03/2023 15.53.49

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

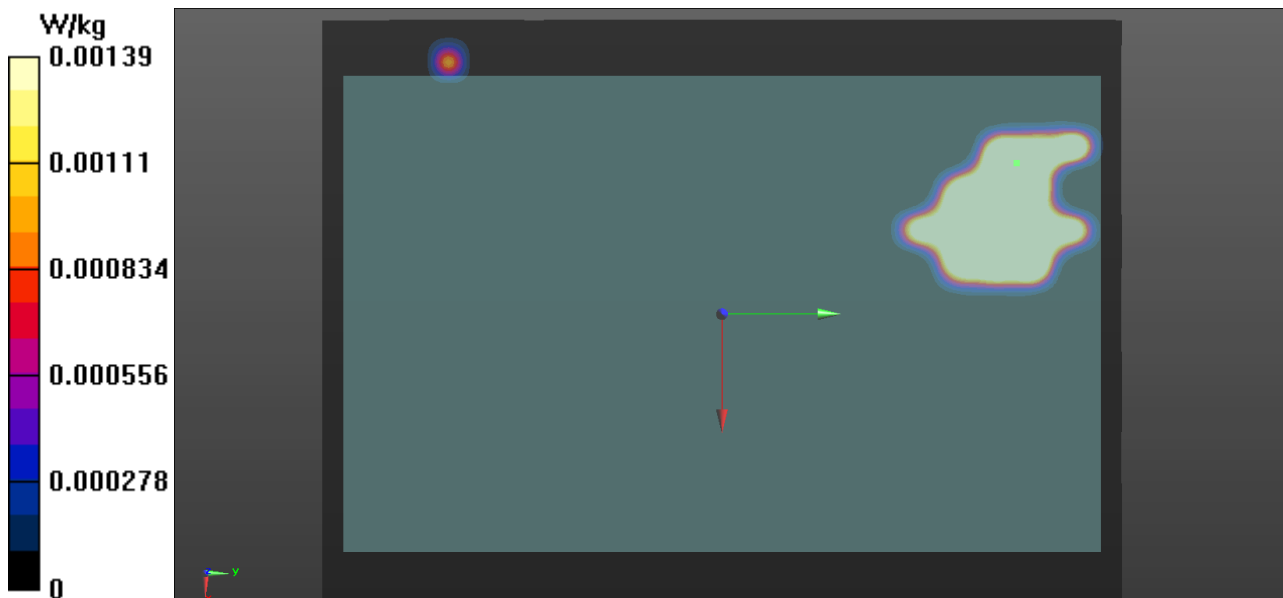
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 12, E-UTRA/FDD (698.0 - 716.0 MHz); Frequency: 711 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 711 \text{ MHz}$; $\sigma = 0.843 \text{ S/m}$; $\epsilon_r = 40.462$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(10.26, 10.26, 10.26) @ 711 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASYS2 52.10.4(1527); SEMCAD X 14.6.12(7450)

Configuration/CrayGen5, LTE12 BW10, QPSK, RBs 1, Offset 24, CH23130/Area Scan (141x191x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$
Maximum value of SAR (interpolated) = 0.00759 W/kg

Configuration/CrayGen5, LTE12 BW10, QPSK, RBs 1, Offset 24, CH23130/Zoom Scan (14x11x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
Reference Value = 0.5610 V/m; Power Drift = -0.27 dB
Peak SAR (extrapolated) = 0 W/kg
SAR(1 g) = n.a. ; SAR(10 g) = n.a. (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00139 W/kg



Plot 16

Date/Time: 06/03/2023 13.47.52

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

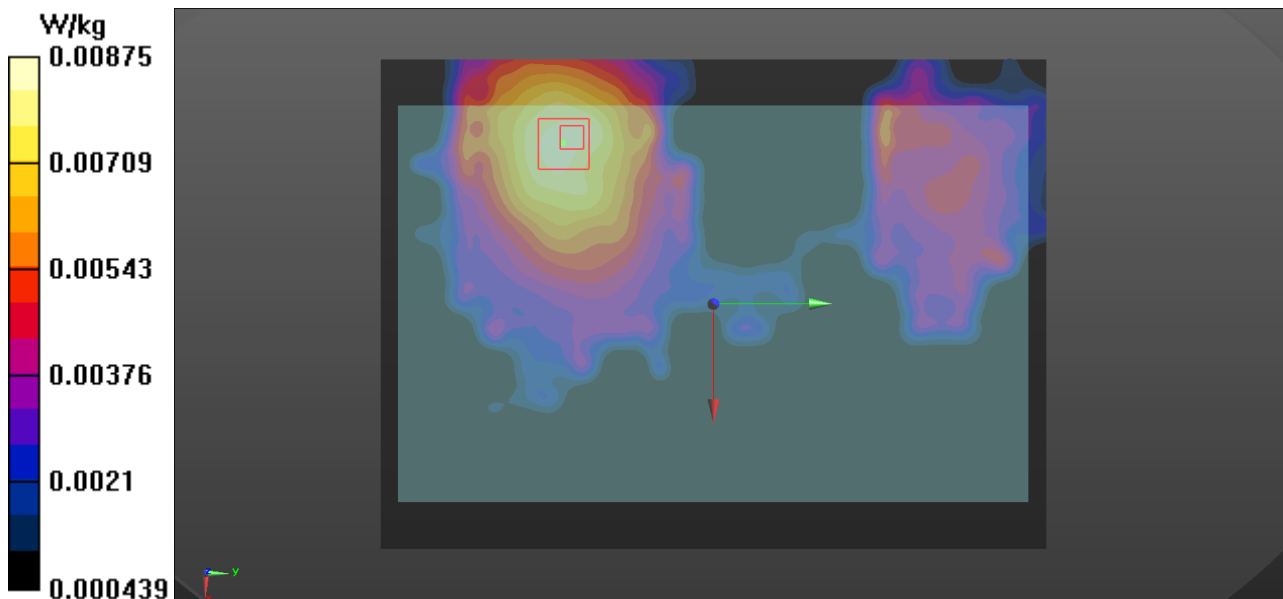
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 13, E-UTRA/FDD (777.0 - 787.0 MHz); Frequency: 782 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 782 \text{ MHz}$; $\sigma = 0.809 \text{ S/m}$; $\epsilon_r = 42.396$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(10.26, 10.26, 10.26) @ 782 MHz; Calibrated: 12/04/2022
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASYS2 52.10.4(1527); SEMCAD X 14.6.12(7450)

06.03.2023/CrayGen5, LTE13, BW10, RBs 25, Offset 12, CH23230/Area Scan (141x191x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$
Maximum value of SAR (interpolated) = 0.00849 W/kg

06.03.2023/CrayGen5, LTE13, BW10, RBs 25, Offset 12, CH23230/Zoom Scan (10x10x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
Reference Value = 2.804 V/m; Power Drift = -0.59 dB
Peak SAR (extrapolated) = 0.00993 W/kg
SAR(1 g) = 0.00749 W/kg; SAR(10 g) = 0.0054 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00875 W/kg



Plot 17

Date/Time: 09/03/2023 12.17.30

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

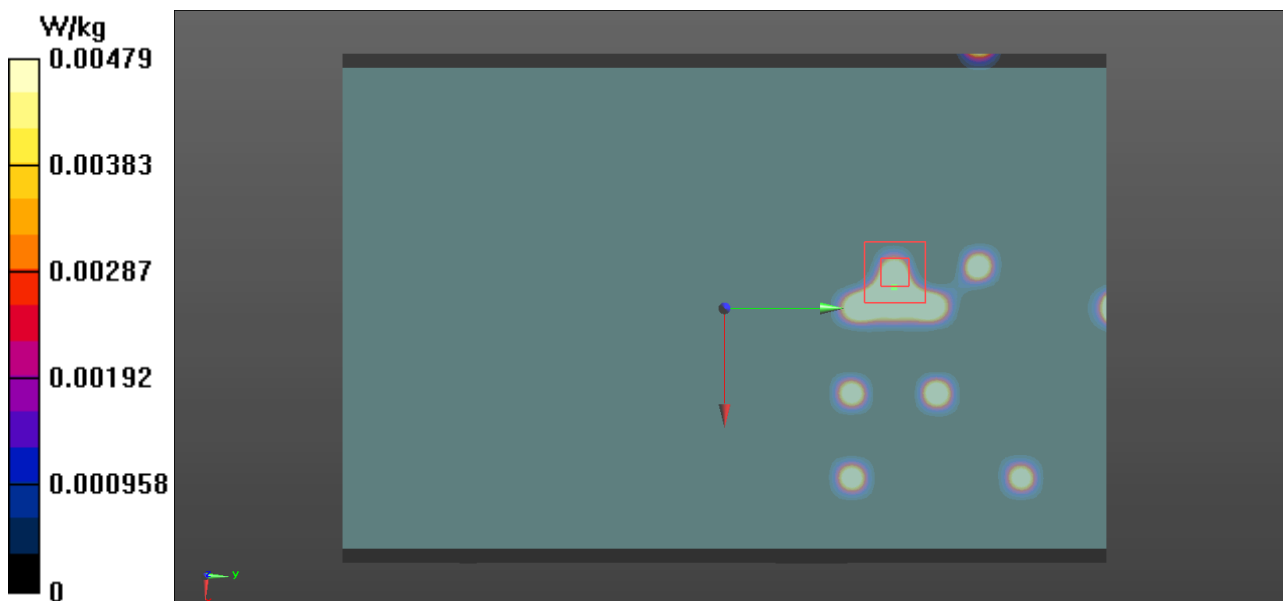
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 66; Frequency: 1770 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 1770$ MHz; $\sigma = 1.251$ S/m; $\epsilon_r = 39.007$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.9, 7.9, 7.9) @ 1770 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: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

09.03.2023 3/CrayGen5, LTE66, BW20, RBs 1, Offset 0, CH132572/Area Scan (121x181x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 0.0167 W/kg

09.03.2023 3/CrayGen5, LTE66, BW20, RBs 1, Offset 0, CH132572/Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 2.989 V/m; Power Drift = -8.16 dB
Peak SAR (extrapolated) = 0.00330 W/kg
SAR(1 g) = 4.34e-005 W/kg; SAR(10 g) = 4.27e-006 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.00479 W/kg



Plot 18

Date/Time: 17.3.23 11:35:05

Test Laboratory: Verkotan Oy

DUT: German Bionics Exoskeleton, CrayGen5;

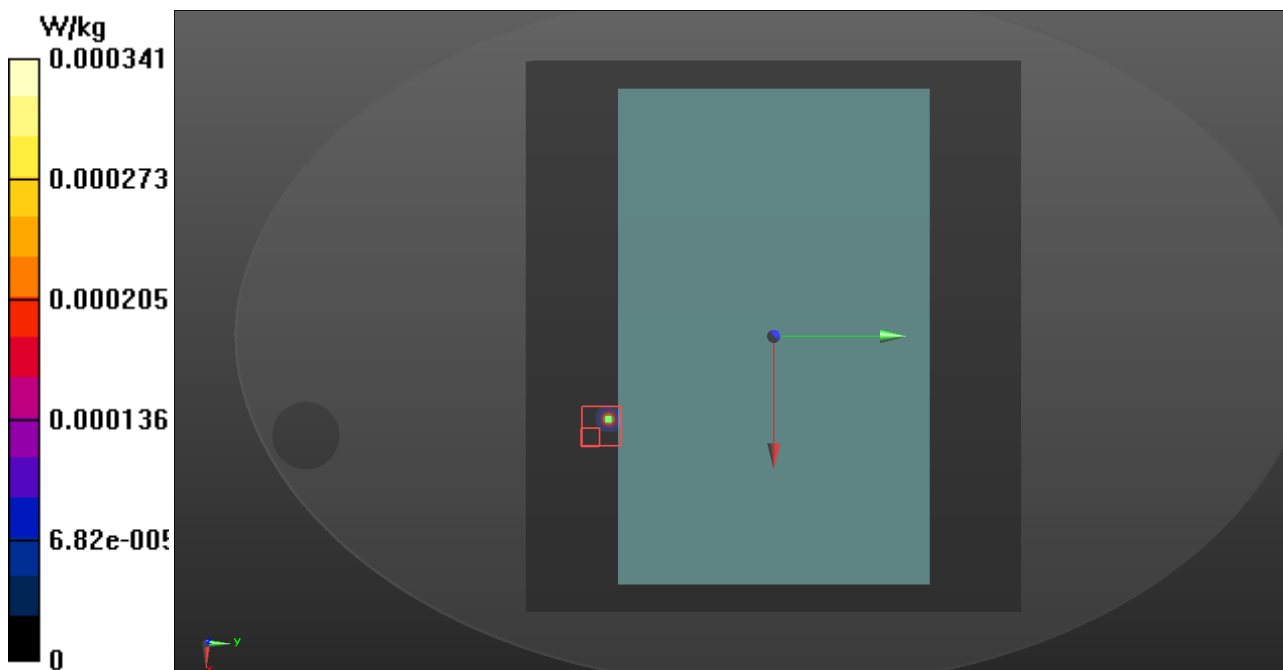
Communication System: UID 0, WLAN 2.4 (0); Communication System Band: WLAN2.4GHz; Frequency: 2412 MHz;
Communication System PAR: 0 dB;
Medium parameters used: $f = 2412$ MHz; $\sigma = 1.731$ S/m; $\epsilon_r = 41.466$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.48, 7.48, 7.48) @ 2412 MHz; Calibrated: 27.10.22
 - Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = -4.0, 31.0$
 - Electronics: DAE4 Sn710; Calibrated: 19.10.22
 - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
 - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/CrayGen5, WLAN 802.11b, CH1, 1Mbps, BW20/Area Scan (201x181x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm
Maximum value of SAR (interpolated) = 0.000341 W/kg

Configuration/CrayGen5, WLAN 802.11b, CH1, 1Mbps, BW20/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm
Reference Value = 0.5040 V/m; Power Drift = 1.17 dB
Peak SAR (extrapolated) = 0.000000291 W/kg
SAR(1 g) = 1.34e-009 W/kg; SAR(10 g) = 6.74e-011 W/kg (SAR corrected for target medium)
Ratio of SAR at M2 to SAR at M1 = 4.4%
Maximum value of SAR (measured) = 0.00130 W/kg



APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **Verkotan**

Certificate No **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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (MATE 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: MY41498087	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

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

Certificate No: EX-3852_Oct22

Page 1 of 9

EX3DV4 - SN:3852

October 27, 2022

Parameters of Probe: EX3DV4 - SN:3852

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k = 2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^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 $\sqrt{\mu\text{V}}$	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 E²-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.

EX3DV4 - SN:3852

October 27, 2022

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.

EX3DV4 - SN:3852

October 27, 2022

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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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **Verkotan**

Certificate No: **EX3-3892_Apr22**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3892**

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

Calibration date: **April 12, 2022**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: CC2552 (20x)	04-Apr-22 (No. 217-03527)	Apr-23
DAE4	SN: 660	13-Oct-21 (No. DAE4-660, Oct21)	Oct-22
Reference Probe ES3DV2	SN: 3013	27-Dec-21 (No. ES3-3013, Dec21)	Dec-22
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: 0B41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by: **Aldona Georgiadou** Function: **Laboratory Technician** Signature:

Approved by: **Sven Kühn** Function: **Deputy Manager** Signature:

Issued: April 12, 2022

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

Certificate No: EX3-3892_Apr22

Page 1 of 9

EX3DV4 – SN:3892

April 12, 2022

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	0.47	0.38	0.47	± 10.1 %
DCP (mV) ^B	102.0	105.5	101.6	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	154.3	± 3.0 %	± 4.7 %
		Y	0.0	0.0	1.0		165.8		
		Z	0.0	0.0	1.0		158.8		

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of Norm X,Y,Z do not affect the E¹-field uncertainty inside TSL (see Page 5).

^B Numerical linearization parameter: uncertainty not required.

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

EX3DV4– SN:3892

April 12, 2022

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

Other Probe Parameters

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

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

EX3DV4- SN:3892

April 12, 2022

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^d	Conductivity (S/m) ^d	ConvF X	ConvF Y	ConvF Z	Alpha ^e	Depth ^e (mm)	Unc (k=2)
600	42.7	0.88	10.43	10.43	10.43	0.10	1.25	± 13.3 %
750	41.9	0.89	10.26	10.26	10.26	0.48	0.80	± 12.0 %
900	41.5	0.97	9.95	9.95	9.95	0.36	0.91	± 12.0 %
1900	40.0	1.40	8.31	8.31	8.31	0.29	0.86	± 12.0 %
2450	39.2	1.60	7.66	7.66	7.66	0.33	0.90	± 12.0 %
2600	39.0	1.96	7.55	7.55	7.55	0.39	0.90	± 12.0 %
4400	36.9	3.84	6.08	6.08	6.08	0.40	1.60	± 13.1 %
4800	36.4	4.25	5.65	5.65	5.65	0.40	1.80	± 13.1 %

^c Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 126, 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.

^d 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.

^e 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

**Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Verkotan**

Certificate No: **D835V2-455_Jul22**

CALIBRATION CERTIFICATE

Object **D835V2 - SN:455**

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: GS39512475	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

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

Issued: July 19, 2022

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

Certificate No: D835V2-455_Jul22

Page 1 of 6

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.3 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.69 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.29 W/kg $\pm$ 16.5 % (k=2)

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Accreditation No.: **SCS 0108**

Client **Verkotan**

Certificate No: **D1800V2-249_Jul22**

CALIBRATION CERTIFICATE

Object **D1800V2 - SN:249**

Calibration procedure(s) **QA CAL-05,v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **July 18, 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: 8H9394 (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: MY41063315	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: US41060477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by: **Joanna Ueshaj** **Laboratory Technician**

Approved by: **Nils Kuster** **Quality Manager**

Signature: *[Signature]*

Issued: July 19, 2022

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Certificate No: D1800V2-249_Jul22

Page 1 of 6

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.4 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	-----	-----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.9 W/kg $\pm$ 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg $\pm$ 16.5 % (k=2)



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).



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.84.5.20.MVGB.A

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 EPG0333
Liquid	Head Liquid Values: ϵ_{ps} : 38.5 sigma : 1.45
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoom 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_r)		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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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.84.5.20.MVGB.A

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	

Page: 8/10

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SAR Reference Dipole Calibration Report

Ref : ACR.343.8.21.BES.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 2600 MHZ
SERIAL NO.: SN 49/21 DIP 2G600-637

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

Calibration date: 12/09/21



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

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Summary:

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

Page: 1/11



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.343.8.21.BES.A

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r)		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 $\pm$ 10 %		0.87 $\pm$ 10 %	
450	43.5 $\pm$ 10 %		0.87 $\pm$ 10 %	
750	41.9 $\pm$ 10 %		0.89 $\pm$ 10 %	
835	41.5 $\pm$ 10 %		0.90 $\pm$ 10 %	
900	41.5 $\pm$ 10 %		0.97 $\pm$ 10 %	
1450	40.5 $\pm$ 10 %		1.20 $\pm$ 10 %	
1500	40.4 $\pm$ 10 %		1.23 $\pm$ 10 %	
1640	40.2 $\pm$ 10 %		1.31 $\pm$ 10 %	
1750	40.1 $\pm$ 10 %		1.37 $\pm$ 10 %	
1800	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1900	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
1950	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2000	40.0 $\pm$ 10 %		1.40 $\pm$ 10 %	
2100	39.8 $\pm$ 10 %		1.49 $\pm$ 10 %	
2300	39.5 $\pm$ 10 %		1.67 $\pm$ 10 %	
2450	39.2 $\pm$ 10 %		1.80 $\pm$ 10 %	
2600	39.0 $\pm$ 10 %	35.7	1.96 $\pm$ 10 %	2.12
3000	38.5 $\pm$ 10 %		2.40 $\pm$ 10 %	
3300	38.2 $\pm$ 10 %		2.71 $\pm$ 10 %	
3500	37.9 $\pm$ 10 %		2.91 $\pm$ 10 %	
3700	37.7 $\pm$ 10 %		3.12 $\pm$ 10 %	
3900	37.5 $\pm$ 10 %		3.32 $\pm$ 10 %	
4200	37.1 $\pm$ 10 %		3.63 $\pm$ 10 %	
4600	36.7 $\pm$ 10 %		4.04 $\pm$ 10 %	
4900	36.3 $\pm$ 10 %		4.35 $\pm$ 10 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 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.

Page: 8/11

Template_ACR.DDD.N.YY.MVGR.ISSUE_SAR Reference Dipole vJ

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.343.8.21.BES.A

Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPG0333
Liquid	Head Liquid Values: ϵ_{ps}^* : 35.7 sigma : 2.12
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	2600 MHz
Input power	20 dBm
Liquid Temperature	20 +/- 1 °C
Lab Temperature	20 +/- 1 °C
Lab Humidity	30-70 %

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	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3	56.47 (5.65)	24.6	24.22 (2.42)
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

Page: 9/11

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



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Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client: **Verkotan**

Certificate No: **D750V3-1154_Jul22**

CALIBRATION CERTIFICATE

Object: **D750V3 - SN:1154**

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: BH8394 (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 E44198	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: US41060477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by: **Aldona Georgiadou** (Name) **Laboratory Technician** (Function) **[Signature]** (Signature)

Approved by: **Niels Kuster** (Name) **Quality Manager** (Function) **[Signature]** (Signature)

Issued: July 19, 2022

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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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.5 $\pm$ 6 %	0.90 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.54 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.57 W/kg $\pm$ 16.5 % (k=2)

**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)
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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 $(22 \pm 3)^{\circ}\text{C}$ 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: US37262783	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

Calibrated by: **Aldonis Georgiadou** Function: **Laboratory Technician**

Approved by: **Niels Kuster** Quality Manager

Signature

Issued: July 19, 2022

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Certificate No: D2450V2-729_Jul22

Page 1 of 6

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 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 $\pm$ 0.2) °C	37.9 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (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 $\pm$ 16.5 % (k=2)