

SAR Compliance Test Report

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Tested device	Rear Seat Entertainment		
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 Technique 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:	08.09.2020		

Laboratory Manager

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (DUT):

Product:	Rear Seat Entertainment
Manufacturer:	JET Optoelectronics CO., LTD.
Model:	BYOC RSE SYSTEM
Serial Number:	W200424B0000050, W200708B0000044
FCC ID Number:	Z3K-BYOCRSE
ISED ID Number:	9930A-BYOCRSE
DUT Number:	22166, 22168
Battery Type used in testing:	-
State of the Sample	Production sample

Testing information:

Testing performed:	14.08.2020, 17.08.2020 – 19.08.2020, 24.08.2020
Notes:	-
Document ID:	FCC ISED SAR report_Rear Seat Entertainment_ID4408_08092020.docx
Temperature °C	22±2 / Controlled
Humidity RH%	30±20 / Controlled
Measurement performed by:	Jesper Varis

1.2 Maximum Results

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

1.2.1 Standalone SAR

System	Highest Reported* SAR _{1g} (W/kg) in Body-Worn Condition, 120mm separation distance	Highest Reported* SAR _{10g} (W/kg) in Extremity Condition, 0mm separation distance	Result
WLAN 2.4GHz	0.006	0.59	PASS

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

1.2.2 Simultaneous Transmission SAR

Highest Simultaneous Transmission SAR	Highest Reported* SAR _{1g} (W/kg) in Body-Worn Configuration	Highest Reported* SAR _{10g} (W/kg) in Extremity Configuration	Result
WLAN 2.4GHz 1 st Chip + WLAN 2.4GHz 2 nd Chip	0.011	1.11	PASS

1.2.3 Maximum Drift

Maximum Drift During Measurements	0.86dB*
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*Larger than 5% drifts included to scaling factors

1.2.4 Measurement Uncertainty

Expanded Uncertainty (k=2) 95 %	±23.4 %
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2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The product is a tablet like Rear Seat Entertainment device.

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)
	2.4GHz WLAN	2412 – 2462
	Bluetooth	2402 – 2480

2.2 Test Exclusions

Since WLAN 2.4GHz and BT use same frequency and antenna on 2nd chip and WLAN tuning power is higher and they cannot transmit simultaneously, the WLAN 2.4GHz standalone SAR is conservative estimation of BT SAR. Thus, BT SAR can be deemed to comply without further analysis or measurements.

2.3 Simultaneous transmission

The device has two WLAN module chips. 1st chip supports only WLAN and 2nd chip supports both WLAN and Bluetooth. WLAN chips can transmit independently or simultaneously. Bluetooth cannot be transmitting at the same with WLAN on the 2nd chip.

Possible simultaneous transmissions are:

- 1st chip WLAN + 2nd chip WLAN
- 1st chip WLAN + 2nd chip Bluetooth

3. OUTPUT POWER

3.1 Maximum specified conducted output power

From the customer, including tune-up tolerances;

WLAN 2.4 GHz	Max Output Power [dBm]
802.11b	15

Bluetooth	Max Output Power [dBm]
Bluetooth	10

3.2 Tested conducted power

WLAN 2.4 GHz 802.11b	Max Output Power [dBm]
CH 1: 2412 MHz	14.82
CH 6: 2437 MHz	14.84
CH 11: 2462 MHz	14.86

4. TEST EQUIPMENT

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

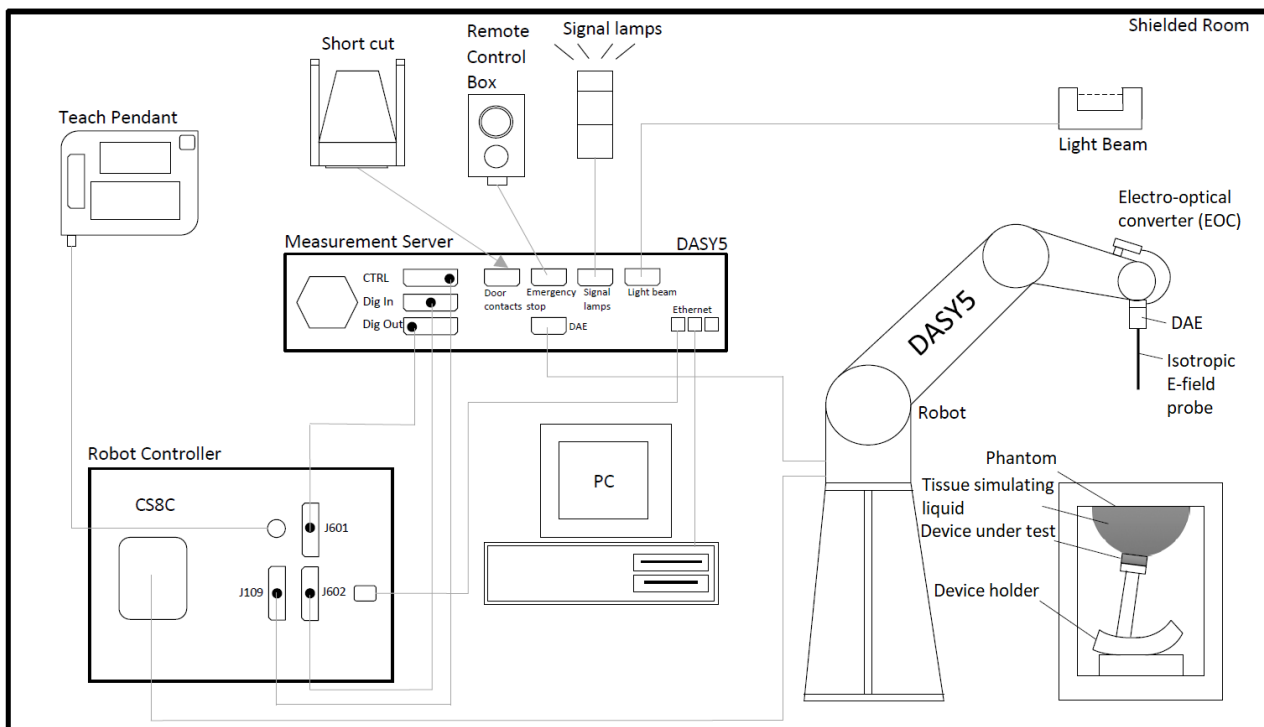


Figure 1 Schematic Laboratory Picture

4.1 Test Equipment List

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

Test Equipment	Model	Serial Number	Calibration Date
DAE	DAE4	705	04.2020
Probe	EX3DV4	7447	03.2020
Dipole	D2450V2	758	03.2020
DASY5 Software	52.8.8.1258	-	NA
Signal generator	Agilent E4438C	MY42082527	NA
Amplifier	Ophir 5163F	1022	NA
Power Reflection Meter	NRT	835065/049	02.2020
Directional Power Sensor	NRT-Z44	835374/021	02.2020
Power Sensor	R&S NRP-Z11	100265	17.12.2019
Spectrum Analyzer	Agilent E445A	MY41000121	NA

4.1.1 Isotropic E-field Probe Type EX3DV4

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix 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 IEEE 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 IEEE 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.

Head 600-6000 MHz tissue simulant liquid Ingredients
Deionized Water, oil, salt, emulsifiers

4.4 System Validation Status

Frequency [MHz]	Dipole Type / SN	Probe Type / SN	Signal Type	DAE Unit / SN	Dielectric Constant ϵ	Conductivity, σ [S/m]	Validation Done
							Head tissue simulant
2450	D2450V2 - SN: 729	EX3DV4 - SN: 7447	CW	DAE 4 / 756	39.503	1.858	04/20

4.5 System Check

Date	Tissue Type	Tissue Temp. [°C]	Frequency [MHz]	Input Power	Measured SAR _{1g} [W/kg]	1 W Target SAR _{1g} [W/kg]	1 W Normalized SAR _{1g} [W/kg]	Deviation (%)	Plot #
13.8.2020	WB HEAD	22±2	2450	250mW	12.8	55.34	51.2	-7.48%	1
17.8.2020	WB HEAD	22±2	2450	250mW	12.5	55.34	50	-9.65%	2
19.8.2020	WB HEAD	22±2	2450	250mW	12.6	55.34	50.4	-8.93%	3
24.8.2020	WB HEAD	22±2	2450	250mW	13	55.34	52	-6.04%	4

4.5.1 Tissue Simulant Verification

				Target		Measured		Deviation	
Date	Tissue Type	Tissue Temp [°C]	Frequency [MHz]	Dielectric Constant [ε] Target	Conductivity σ [S/m] Target	Dielectric Constant [ε]	Conductivity σ [S/m]	ε (%)	σ (%)
13.08.2020	WB Head	22	2412	39.27	1.77	36.39	1.77	-7.3	0.3
13.08.2020	WB Head	22	2437	39.22	1.79	36.38	1.79	-7.2	0.2
13.08.2020	WB Head	22	2450	39.2	1.8	36.38	1.8	-7.2	-0.1
13.08.2020	WB Head	22	2462	39.18	1.81	36.32	1.81	-7.3	-0.2
17.08.2020	WB Head	22	2412	39.27	1.77	37.57	1.79	-4.3	1.6
17.08.2020	WB Head	22	2437	39.22	1.79	37.52	1.81	-4.3	1.4
17.08.2020	WB Head	22	2450	39.2	1.8	37.5	1.82	-4.3	1.3
17.08.2020	WB Head	22	2462	39.18	1.81	37.49	1.83	-4.3	1.1
19.08.2020	WB Head	22	2450	39.2	1.8	37.17	1.82	-5.2	1.0
19.08.2020	WB Head	22	2462	39.18	1.81	37.14	1.83	-5.2	0.8
24.08.2020	WB Head	22	2412	39.27	1.77	37.62	1.82	-4.2	2.8
24.08.2020	WB Head	22	2437	39.22	1.79	37.57	1.84	-4.2	2.7
24.08.2020	WB Head	22	2450	39.2	1.8	37.56	1.85	-4.2	2.6

5. TEST PROCEDURE

Testing was carried out in accordance with FCC KDB Publications 447498 D01, 248227 D01 802.11 Wi-Fi SAR and RSS-102.

According to the manufacturer, when the device is installed to a normal position in the back side of the front seat in cars, the foreseeable separation distance to a person sitting in the front seat is 12cm. For the back passenger, the separation distance to body is greater than 20cm.

Since the device has a touch screen, Extremity SAR was tested from the front side of the device at 0mm separation distance. Body SAR was tested from the back side of the device at 120mm separation distance.

During testing, the WLAN transmission was set to transmit on maximum output power with software.

The WLAN transmission mode for testing were selected according to largest channel bandwidth configuration with the lowest order modulation and lowest data rate. 2.4GHz WLAN was tested with 802.11b standard with data rate 1Mbit/s.

5.1 Test Positions

5.1.1 Body-worn Configuration, 120mm separation distance

The device was placed on the top of the Rohacell the back side of the device towards the phantom. The device was lifted towards the phantom until the distance between the phantom and edge of the device was 120mm.

Photos of the test positions are presented in appendix A.

5.1.2 Extremity Configuration, 0mm separation distance

Extremity SAR was tested from the front side of the device. The device was placed on the top of a Rohacell and lifted towards the phantom until the distance between the phantom and front (display) of the device was 0mm.

Antenna location and 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

Uncertainty Budget IEEE 1528-2013								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0 %	N	1	1	1	±6.0 %	±6.0 %	∞
Axial Isotropy	±4.7 %	R		0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	1.73	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	1.73	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	1.73	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	1.73	1	1	±0.6 %	±0.6 %	∞
Modulation Response ^m	±2.4 %	R	1.73	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	1.73	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	1.73	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	1.73	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	1.73	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	1.73	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	1.73	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±2.0 %	R	1.73	1	1	±1.2 %	±1.2 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	1.73	1	1	±2.9 %	±2.9 %	∞
Power Scaling	±6 %	R	1.73	1	1	±3.5 %	± 3.5%	∞
Phantom and Setup								
Phantom Uncertainty	±6.1 %	R	1.73	1	1	±3.5 %	±3.5 %	∞
SAR correction	±1.9 %	R	1.73	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)	±2.5 %	R	1.73	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.)	±2.5 %	R	1.73	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity	±3.4 %	R	1.73	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity	±0.4 %	R	1.73	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±11.7 %	±11.6 %	361
Expanded STD Uncertainty						±23.4 %	±23.3 %	

7. TEST RESULTS

7.1 SAR Results for Extremity Condition with 0mm separation

WLAN 2.4GHz, 1st Chip

Mode	Data Rate [Mbps]	Freq [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR _{10g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Reported SAR _{10g} [W/kg]	Plot #
802.11b	1	2462	11	Front	15	14.86	0.41	0.86*	1.26	1:1	0.52	5
802.11b	1	2412	1	Front	15	14.82	0.398	0.33*	1.12	1:1	0.45	
802.11b	1	2437	6	Front	15	14.84	0.407	0.25*	1.10	1:1	0.45	

*Larger than 5% drifts included to scaling factors

WLAN 2.4GHz, 2nd Chip

Mode	Data Rate [Mbps]	Freq [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR _{10g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Reported SAR _{10g} [W/kg]	Plot #
802.11b	1	2462	11	Front	15	14.86	0.473	0.85*	1.26	1:1	0.59	6
802.11b	1	2412	1	Front	15	14.82	0.435	0.57*	1.19	1:1	0.52	
802.11b	1	2437	6	Front	15	14.84	0.457	0.8*	1.25	1:1	0.57	

*Larger than 5% drifts included to scaling factors

7.2 SAR Results for Body Exposure Condition with 120mm separation

WLAN 2.4GHz, 1st Chip

Mode	Data Rate [Mbps]	Freq [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR _{1g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Reported SAR _{1g} [W/kg]	Plot #
802.11b	1	2462	11	Back	15	14.86	0.00492	0.05	1.03	1:1	0.005	
802.11b	1	2437	6	Back	15	14.84	0.00358	0.29*	1.11	1:1	0.004	
802.11b	1	2412	1	Back	15	14.82	0.00339	NA**	1.04	1:1	0.004	

*Larger than 5% drifts included to scaling factors

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

WLAN 2.4GHz, 2nd Chip

Mode	Data Rate [Mbps]	Freq [MHz]	Channel	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR _{1g} [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Reported SAR _{1g} [W/kg]	Plot #
802.11b	1	2462	11	Back	15	14.86	0.00537	0.48*	1.15	1:1	0.006	
802.11b	1	2437	6	Back	15	14.84	0.00378	0.69*	1.22	1:1	0.005	
802.11b	1	2412	1	Back	15	14.82	0.00335	0.47*	1.27	1:1	0.004	

*Larger than 5% drifts included to scaling factors

7.2.1 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%.

All Zoom scan peak spatial-average SAR results over 0.1 W/kg are in the table below.

Filename	Horizontal Grid Step [mm]	Minimum Distance [mm]	M2/M1 Ratio [%]	Result
1 st Chip WLAN 802.11b CH 11 Front	5.0	7.1	40.6	PASS
1 st Chip WLAN 802.11b CH 1 Front	5.0	7.1	40.8	PASS
1 st Chip WLAN 802.11b CH 6 Front	5.0	7.1	40.8	PASS
2 nd Chip WLAN 802.11b CH 11 Front	4.0	5.6	40.6	PASS
2 nd Chip WLAN 802.11b CH 1 Front	5.0	7.1	41.2	PASS
2 nd Chip WLAN 802.11b CH 6 front	5.0	7	41.9	PASS

7.3 Simultaneous Transmission Analysis

Simultaneous transmission analysis for the maximum WLAN SAR 1st Chip and the maximum WLAN SAR 2nd Chip is in the table below. Direct summation of SAR results was performed.

Transmission Mode	Exposure Condition	
	Maximum Body SAR _{1g} [W/kg]	Maximum Extremity SAR _{10g} [W/kg]
WLAN 2.4GHz 1 st Chip	0.005	0.52
WLAN 2.4GHz 2 nd Chip	0.006	0.59
SAR Summation: EN 62209-1 6.4.3.2.2 Alternative 1	0.011	1.11

APPENDIX A: PHOTOS OF THE DUT

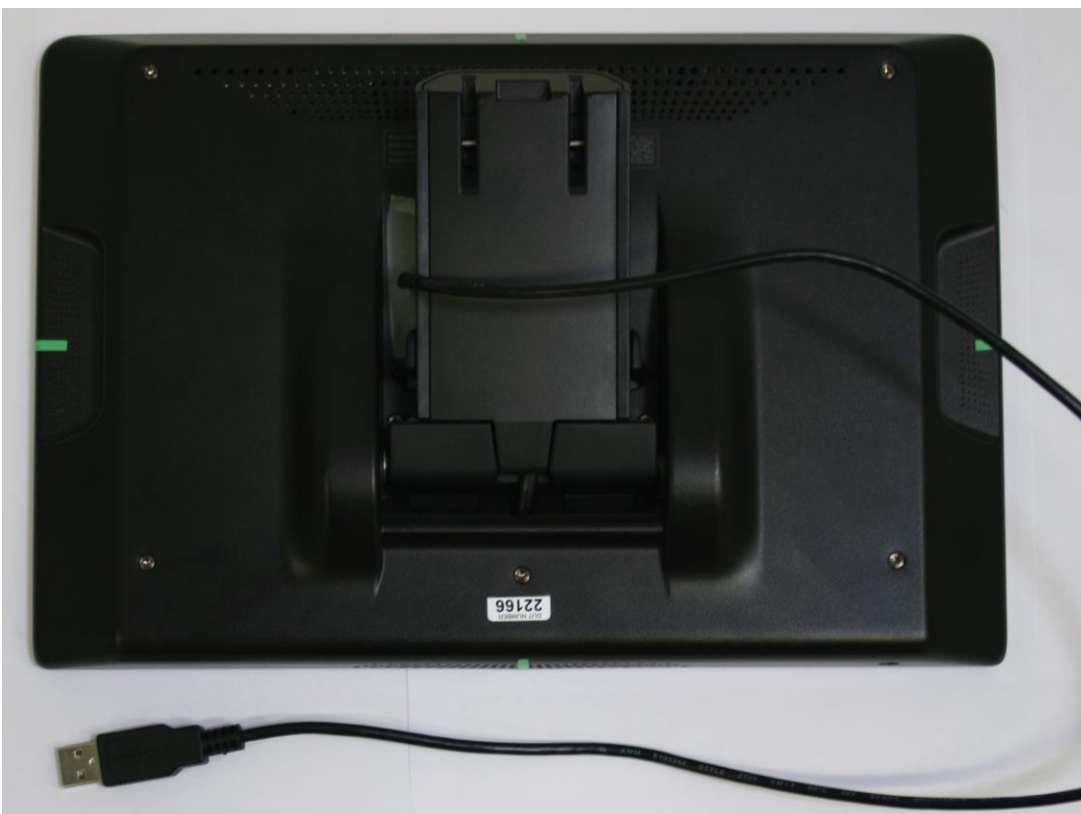
Size of the DUT is: 285x195x22 mm.

Antenna location:

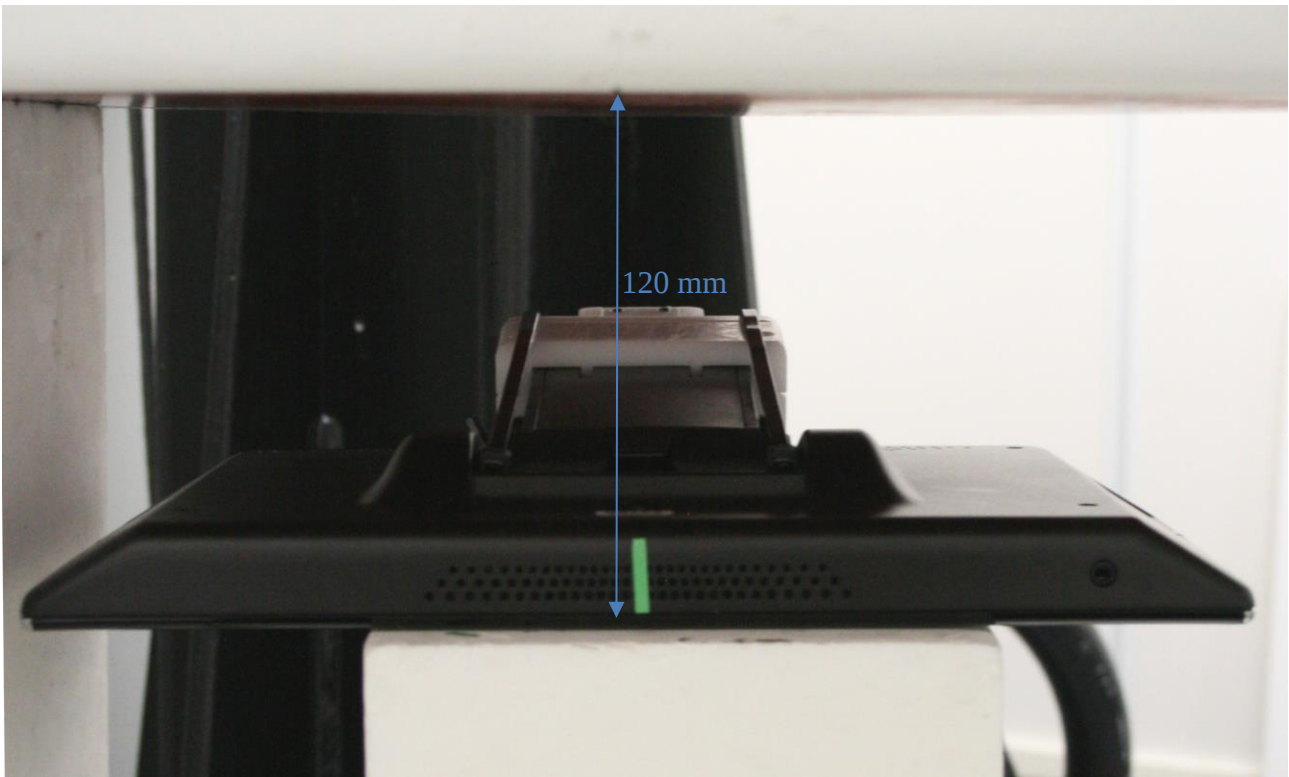




Front side of the device



Back side of the device



Back side of the device against the phantom, 120 mm separation distance



Front side of the device against the phantom, 0 mm separation distance

APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 13.8.2020 17:28:06

Test Laboratory: Verkotan Oy

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:758

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.798$ S/m; $\epsilon_r = 36.384$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.83, 7.83, 7.83); Calibrated: 25.3.2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0, -4.0$
- Electronics: DAE4 Sn705; Calibrated: 24.4.2020
- Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA
- DASYS2 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5$ mm, $dy=7.5$ mm, $dz=5$ mm

Reference Value = 103.2 V/m; Power Drift = -0.07 dB

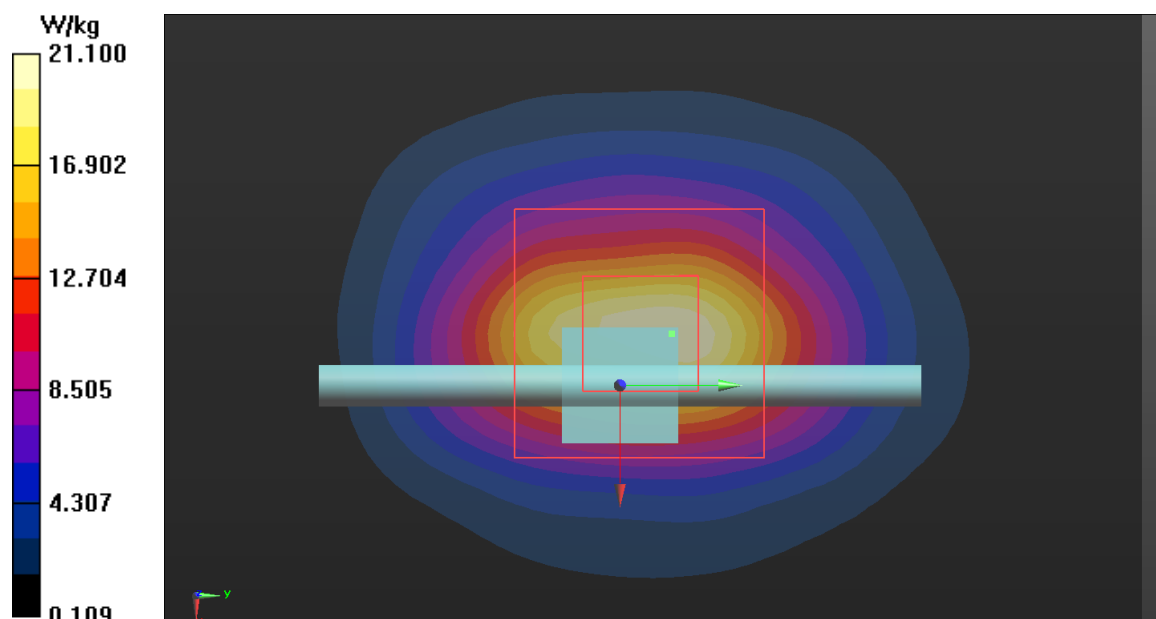
Peak SAR (extrapolated) = 26.4 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.93 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 21.1 W/kg

Configuration/system check/Area Scan (61x61x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 22.5 W/kg



Plot 2

Date/Time: 17.8.2020 10:10:50

Test Laboratory: Verkotan Oy

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:758

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.823$ S/m; $\epsilon_r = 37.504$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.83, 7.83, 7.83); Calibrated: 25.3.2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0, -4.0$
- Electronics: DAE4 Sn705; Calibrated: 24.4.2020
- Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA
- DASYS2 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5$ mm, $dy=7.5$ mm, $dz=5$ mm

Reference Value = 108.9 V/m; Power Drift = -0.05 dB

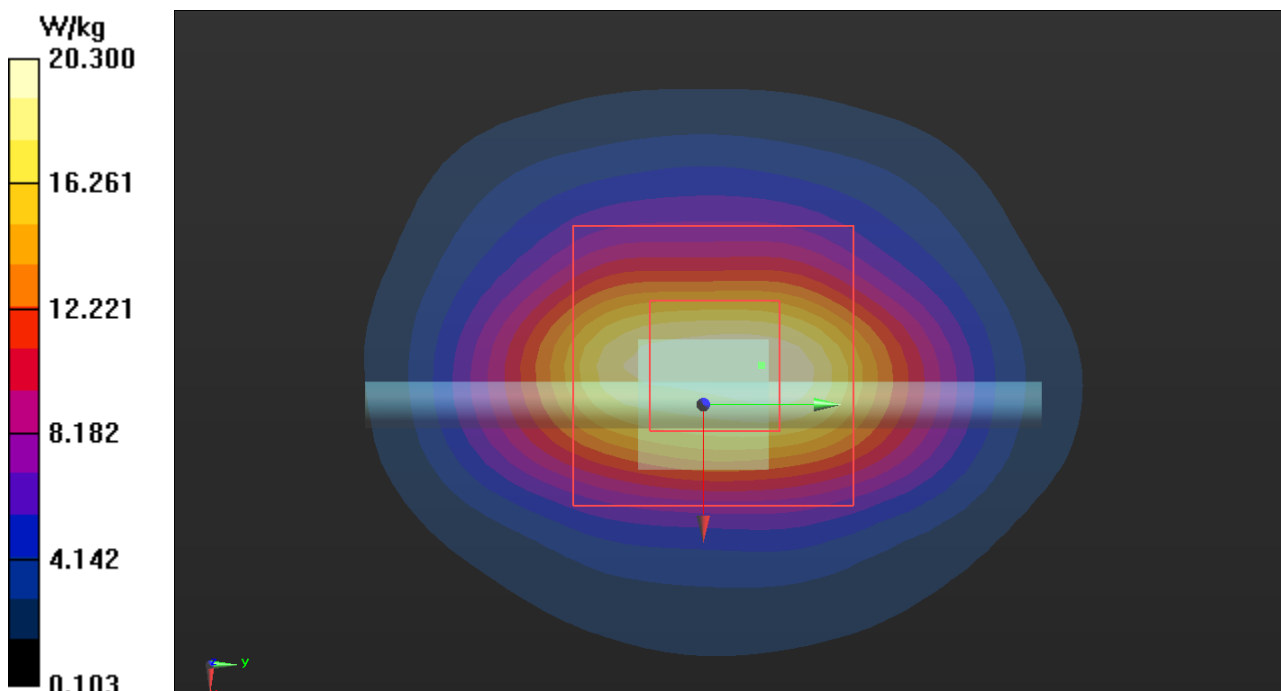
Peak SAR (extrapolated) = 25.6 W/kg

SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.86 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 20.3 W/kg

Configuration/system check/Area Scan (61x61x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 22.0 W/kg



Plot 3

Date/Time: 19.8.2020 8:40:36

Test Laboratory: Verkotan Oy

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:758

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.818$ S/m; $\epsilon_r = 37.17$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.83, 7.83, 7.83); Calibrated: 25.3.2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0, -4.0$
- Electronics: DAE4 Sn705; Calibrated: 24.4.2020
- Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5$ mm, $dy=7.5$ mm, $dz=5$ mm

Reference Value = 105.8 V/m; Power Drift = -0.09 dB

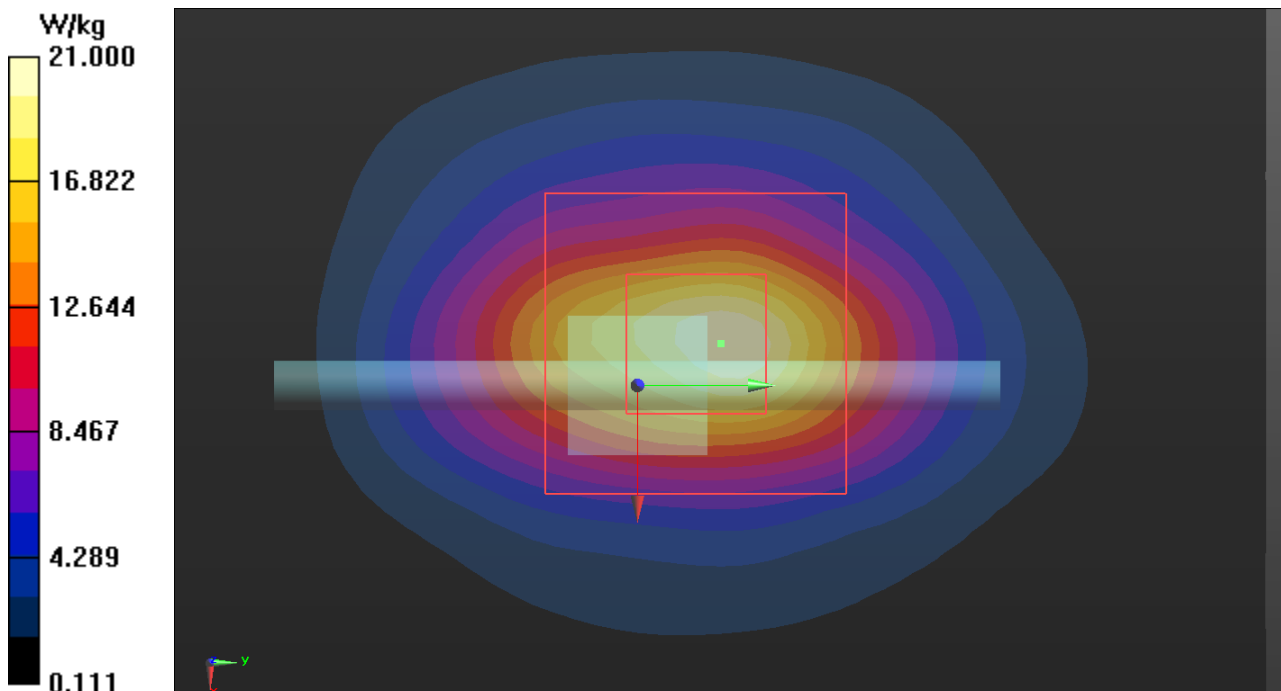
Peak SAR (extrapolated) = 25.9 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.86 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 21.0 W/kg

Configuration/system check/Area Scan (61x61x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 23.6 W/kg



Plot 4

Date/Time: 24.8.2020 8:49:44

Test Laboratory: Verkotan Oy

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:578

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.847$ S/m; $\epsilon_r = 37.556$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.83, 7.83, 7.83); Calibrated: 25.3.2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0, -4.0$
- Electronics: DAE4 Sn705; Calibrated: 24.4.2020
- Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5$ mm, $dy=7.5$ mm, $dz=5$ mm

Reference Value = 104.8 V/m; Power Drift = -0.00 dB

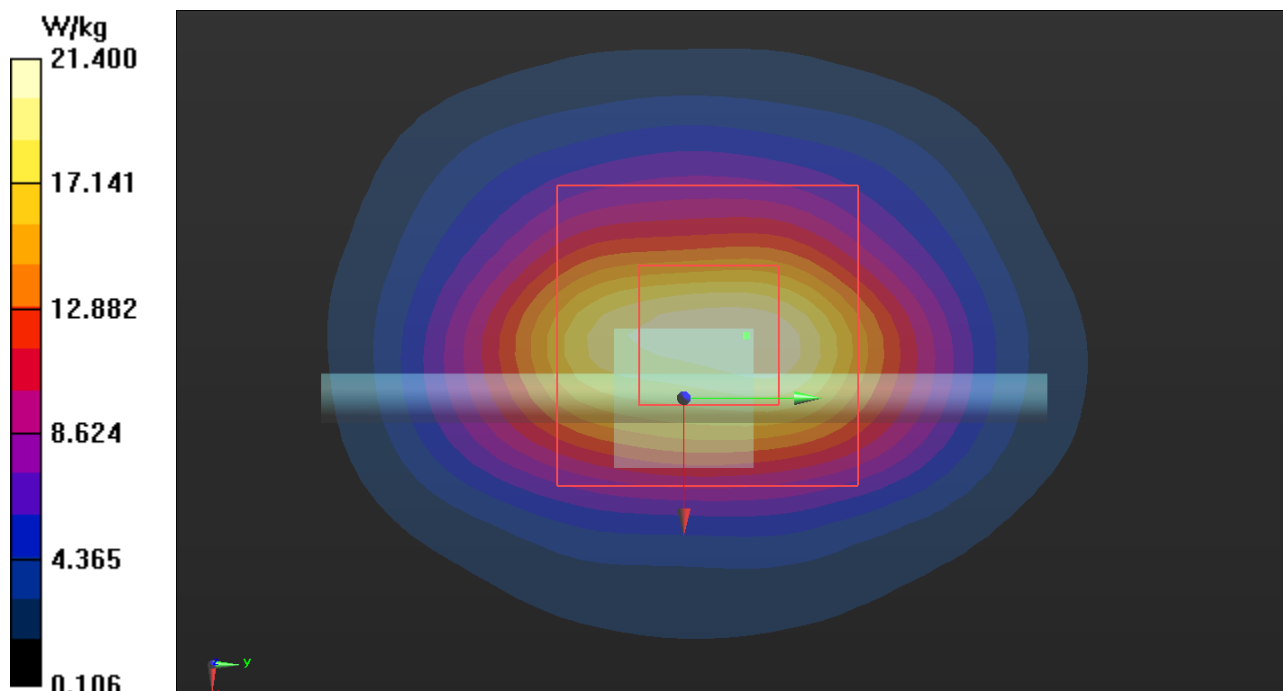
Peak SAR (extrapolated) = 26.9 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.01 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 21.4 W/kg

Configuration/system check/Area Scan (61x61x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 22.5 W/kg



APPENDIX C: MEASUREMENT SCANS

Plot 5

Date/Time: 14.8.2020 15:19:43

Test Laboratory: Verkotan Oy

DUT: Rear Seat Entertainment

Communication System: UID 0, WLAN 2.4 (0); Communication System Band: WLAN2.4GHz; Frequency: 2462 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: $f = 2462$ MHz; $\sigma = 1.809$ S/m; $\epsilon_r = 36.322$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.83, 7.83, 7.83); Calibrated: 25.3.2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0, -4.0$
- Electronics: DAE4 Sn705; Calibrated: 24.4.2020
- Phantom: SAR1_Phantom1_EL1; Type: QD OVA 002 AA
- DASYS2 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration 3/WLAN 802.11b CH 11 Front/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 3.053 V/m; Power Drift = 0.86 dB

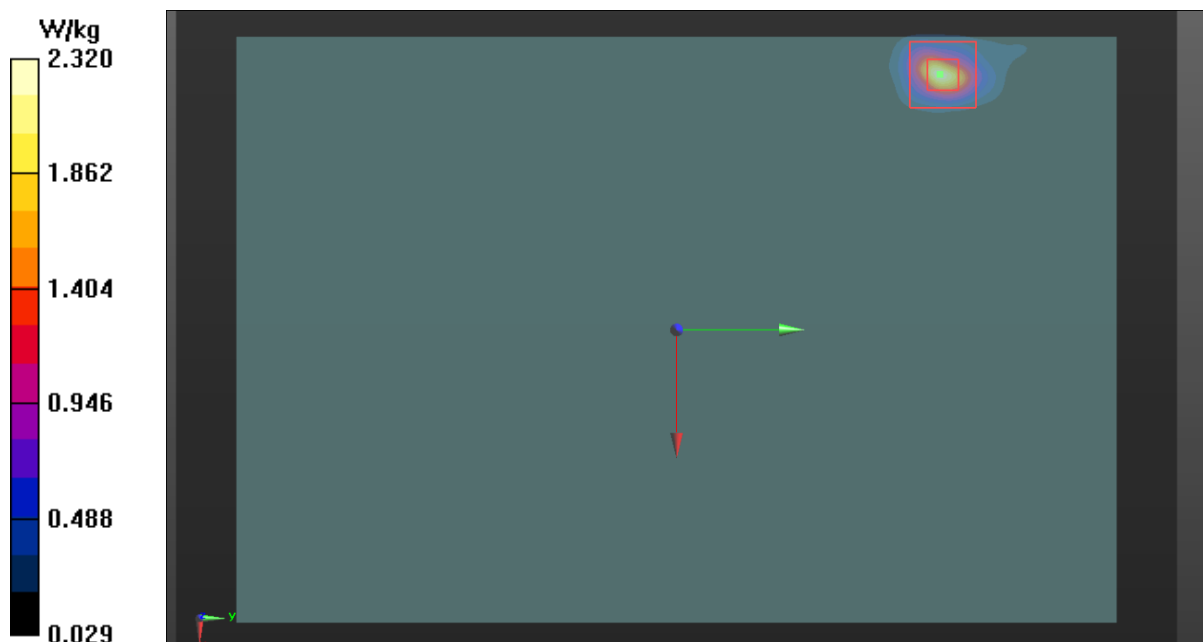
Peak SAR (extrapolated) = 3.15 W/kg

SAR(1 g) = 1.16 W/kg; SAR(10 g) = 0.410 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 2.32 W/kg

Configuration 3/WLAN 802.11b CH 11 Front/Area Scan (191x271x1): Interpolated grid: $dx=1.200$ mm, $dy=1.200$ mm

Maximum value of SAR (interpolated) = 2.37 W/kg



Plot 6

Date/Time: 19.8.2020 10:04:28

Test Laboratory: Verkotan Oy

DUT: Rear Seat Entertainment

Communication System: UID 0, WLAN 2.4 (0); Communication System Band: WLAN2.4GHz; Frequency: 2462 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: $f = 2462$ MHz; $\sigma = 1.828$ S/m; $\epsilon_r = 37.141$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.83, 7.83, 7.83); Calibrated: 25.3.2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 31.0, -4.0$
- Electronics: DAE4 Sn705; Calibrated: 24.4.2020
- Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/2nd Chip WLAN 802.11b CH 11 Front/Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=5$ mm

Reference Value = 3.496 V/m; Power Drift = 0.85 dB

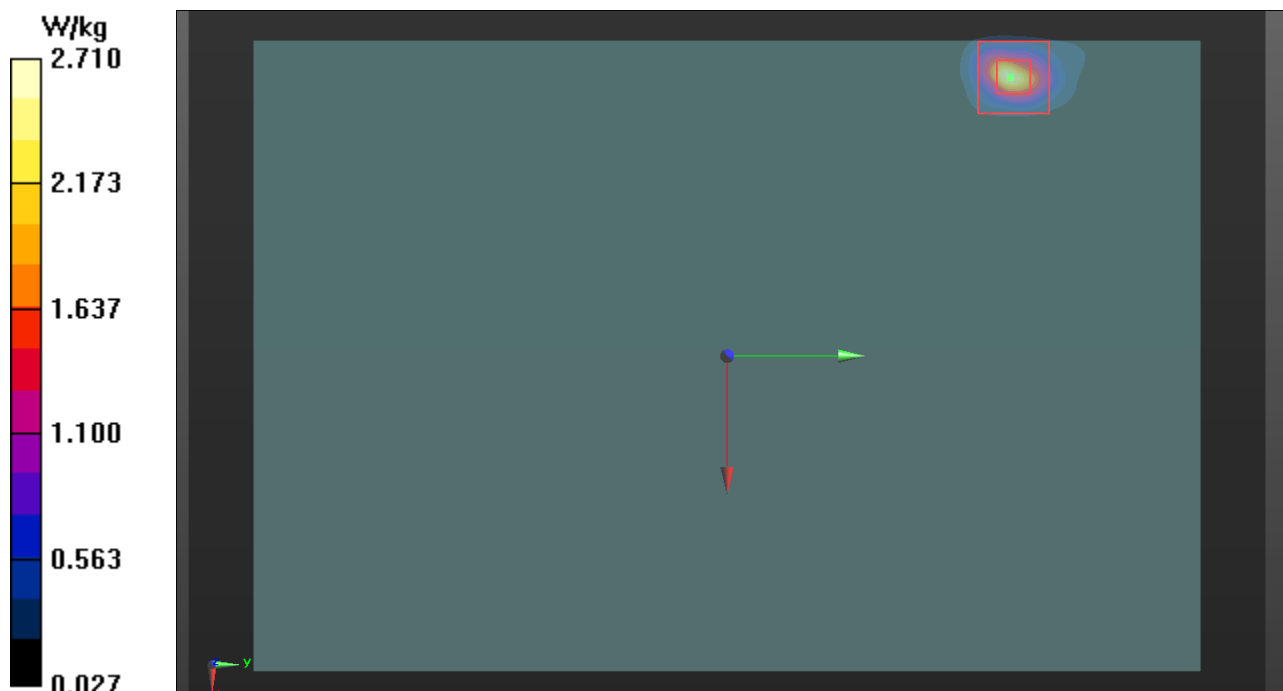
Peak SAR (extrapolated) = 3.73 W/kg

SAR(1 g) = 1.34 W/kg; SAR(10 g) = 0.473 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 2.71 W/kg

Configuration/2nd Chip WLAN 802.11b CH 11 Front/Area Scan (191x271x1): Interpolated grid: $dx=1.200$ mm, $dy=1.200$ mm

Maximum value of SAR (interpolated) = 3.09 W/kg



APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS

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



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

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client **Verkotan**

Certificate No: **EX3-7447_Mar20**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:7447**

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

Calibration date: **March 25, 2020**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	27-Dec-19 (No. DAE4-660_Dec19)	Dec-20
Reference Probe ES3DV2	SN: 3013	31-Dec-19 (No. ES3-3013_Dec19)	Dec-20
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Jeton Kastrali	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: March 27, 2020			

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

EX3DV4 – SN:7447

March 25, 2020

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7447

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.41	0.42	0.42	± 10.1 %
DCP (mV) ^B	98.5	91.0	100.2	

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 ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	197.2	± 2.7 %	± 4.7 %
		Y	0.0	0.0	1.0		185.8		
		Z	0.0	0.0	1.0		172.3		

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

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 5).

^B Numerical linearization parameter: uncertainty not required.

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

EX3DV4- SN:7447

March 25, 2020

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7447

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unc (k=2)
750	41.9	0.89	10.38	10.38	10.38	0.52	0.88	± 12.0 %
900	41.5	0.97	9.97	9.97	9.97	0.31	1.05	± 12.0 %
1750	40.1	1.37	8.65	8.65	8.65	0.29	0.88	± 12.0 %
1950	40.0	1.40	8.29	8.29	8.29	0.23	0.98	± 12.0 %
2150	39.7	1.53	8.21	8.21	8.21	0.29	0.88	± 12.0 %
2300	39.5	1.67	8.05	8.05	8.05	0.30	1.00	± 12.0 %
2450	39.2	1.80	7.83	7.83	7.83	0.29	1.00	± 12.0 %
2600	39.0	1.96	7.64	7.64	7.64	0.19	1.20	± 12.0 %
3300	38.2	2.71	7.00	7.00	7.00	0.30	1.30	± 13.1 %
5250	35.9	4.71	5.18	5.18	5.18	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.56	4.56	4.56	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.70	4.70	4.70	0.40	1.80	± 13.1 %

^c Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^g Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

APPENDIX E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS



SAR Reference Dipole Calibration Report

Ref : ACR.84.6.20.MVGB.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
SAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 758

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.84.6.20.MVGB.A

	<i>Name</i>	<i>Function</i>	<i>Date</i>	<i>Signature</i>
<i>Prepared by :</i>	Jérôme LUC	Technical Manager	3/24/2020	
<i>Checked by :</i>	Jérôme LUC	Technical Manager	3/24/2020	
<i>Approved by :</i>	Yann Toutain	Laboratory Director	3/24/2020	

	<i>Customer Name</i>
<i>Distribution :</i>	Verkotan Ltd.

<i>Issue</i>	<i>Name</i>	<i>Date</i>	<i>Modifications</i>
A	Jérôme LUC	3/24/2020	Initial release



SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.84.6.20.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} : 37.5 σ : 1.80
Distance between dipole center and liquid	10.0 mm
Area scan resolution	$dx=8mm/dy=8mm$
Zoon Scan Resolution	$dx=5mm/dy=5mm/dz=5mm$
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	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 %		1.40 ±10 %	
1950	40.0 ±10 %		1.40 ±10 %	
2000	40.0 ±10 %		1.40 ±10 %	
2100	39.8 ±10 %		1.49 ±10 %	

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.84.6.20.MVGB.A

2300	39.5 ±10 %		1.67 ±10 %	
2450	39.2 ±10 %	37.5	1.80 ±10 %	1.80
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		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	55.34 (5.53)	24	24.43 (2.44)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	

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