

SAR Compliance Test Report

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Tested device:	V200/SR303		
Related reports:	-		
Testing has been carried out in accordance with:	47CFR §2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices FCC published RF exposure KDB procedures IEC/IEEE 62209-1528, 2020 Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices		
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:	20.08.2024 Laboratory Manager <i>Miia Nurkkala</i>		

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Device under Test (DUT):

Product:	GMDSS Handheld VHF Radio
Manufacturer:	Ocean Signal
Model:	V200/SR303
Serial Number:	V200 - TA005 SR303 - TA006
Hardware Version:	V1.1
FCC ID Number:	XYEV200
DUT Number:	V200: 20372 SR303: 20384
Battery Type used in testing:	Rechargeable Lithium Battery 3.7V 11.1Wh
State of the Sample:	Production sample

Testing information:

Testing performed:	13.08.2024 – 16.08.2024
Notes:	-
Document history:	Initial version
Document ID:	FCC_SAR report_V200 SR303_ID6651_20082024.docx
Temperature °C	22±2 / Controlled
Humidity RH%	30±20 / Controlled
Measurement performed by:	Ilari Kinnunen
FCC Test Firm Designation Number:	FI0005

1.2 Maximum Results

The maximum reported* SAR values for Body-worn 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 Head/Body SAR_{1g} is 1.6 W/kg and for Extremity SAR_{10g} is 4.0 W/kg.

1.2.1 Standalone SAR

System	Highest Reported* SAR _{1g} [W/kg] in Body-Worn Exposure Condition, 0mm separation distance	Highest Reported* SAR _{10g} [W/kg] in Extremity Exposure Condition, 0mm separation distance	Result
VHF	0.76	0.63	PASS

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

1.2.2 Maximum Drift

Maximum Drift During Measurements	0.6 dB*
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*Larger than 5% drifts included to scaling factors

1.2.3 Measurement Uncertainty

SAR 1g: IEC 62209-1528 (4MHz – 300MHz)

Expanded Uncertainty (k=2) 95 %	±22.7 %
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SAR 10g: IEC 62209-1528 (4MHz – 300MHz)

Expanded Uncertainty (k=2) 95 %	±22.5 %
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2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is a GMDSS Handheld VHF Push-to-talk Radio that supports VHF at 156.025 – 157.425 MHz frequencies. Models V200 and SR303 are included in this test report as they are essentially identical with different branding.



Figure 1 Overview of DUTs V200 & SR303

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]
	VHF	156.025 – 157.425

3. OUTPUT POWER

3.1 Maximum specified conducted output power

From the customer, including tune-up tolerances;

Technology	Max Output Power [dBm]
VHF	36.99

3.2 Tested conducted power

Measured conducted output power at transmitting antenna connector;

Technology	Frequency [MHz]	Channel	Output Power [dBm]
VHF	156.025	60	36.59
VHF	156.7	14	36.8
VHF	157.425	88	36.61

4. TEST EQUIPMENT

Dasy 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.

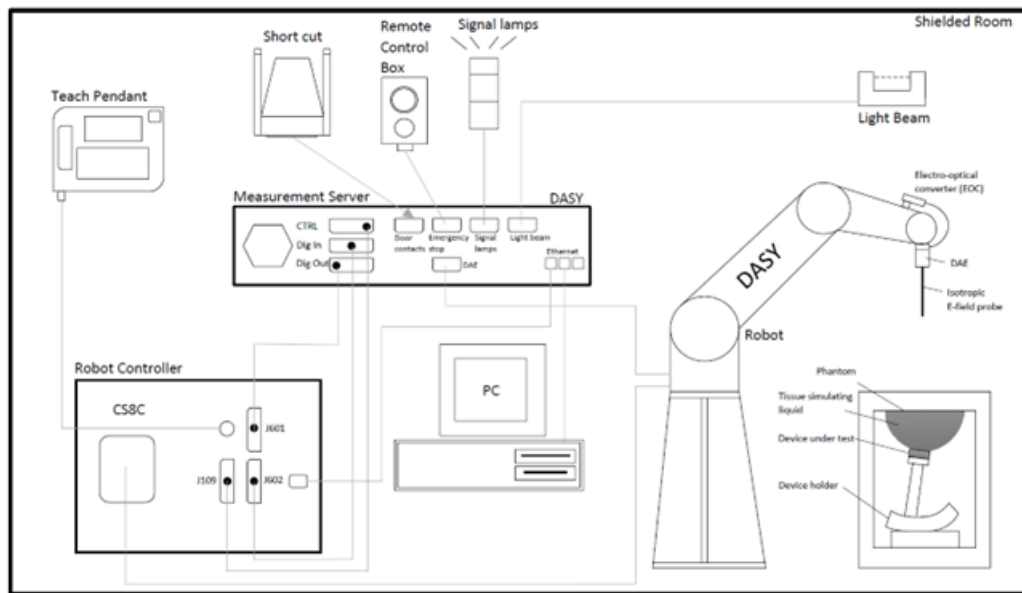


Figure 2 Schematic Laboratory Picture

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	Interval [years]
Amplifier, 0.5-1000MHz	TVA-R5-13A+	2202002	NA	NA
Isotropic DOS probe	EX3DV4	3852	10/2023	1
Network Analyzer	E5071B	MY42301191	03/2024	1
Power Sensor	NRP8S	1419.0006K02-108509-Zh	03/2024	2
Power Sensor	NRP8S	1419.0006K02-108508-HC	09/2023	2
System validation dipole	CLA150	4027	07/2022	3
Vector Signal Generator	SMP02	836402/004	NA	NA
DAE4, converter	DAE4ip	1774	06/2024	1
DASY8 Software	16.2.4.2524	-	NA	NA

Dipole calibration period supporting data:

Antenna and serial number	Frequency (MHz)	Measured on 09/2023			Calibrated		
		Return loss (dB)	Impedance (Ω)		Return loss (dB)	Impedance (Ω)	
CLA150 - SN:4027	150	-30.2	53.2	0.4	-27.4	48.5	-3.9

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	4 MHz to 10 GHz (dosimetry) Linearity: ± 0.2 dB (30 MHz to 10 GHz)
Directivity (typical)	± 0.1 dB in TSL (rotation around probe axis) ± 0.3 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 μ W/g – >100 mW/g Linearity: ± 0.2 dB (noise: typically <1 μ W/g)
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 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 4 MHz to 10 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 DASY with which measured peak average SAR values were corrected for the deviation of used liquid. Depth of the tissue simulant was at least 15.0 cm from the inner surface of the flat phantom.

Tissue simulant liquid Ingredients
Deionized Water, tween, salt

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]	Date
150	CLA 150 - SN: 4027	EX3DV4 - SN: 3852	SMC	DAE4ip / 1774	48.17	0.72	08/2024

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 #
14.08.2024	WB Head	22	150	100	0.355	3.63	3.55	-2.2	1
15.08.2024	WB Head	22	150	250	0.89	3.63	3.56	-1.9	2

4.6 Tissue Simulant Verification

				Measured		Target		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 [%]
13.08.2024	WB Head	22	150	52.3	0.76	48.2	0.72	-7.9	-4.9
13.08.2024	WB Head	22	156.7	52.0	0.76	48.0	0.73	-7.6	-5.1
15.08.2024	WB Head	22	150	52.3	0.76	48.6	0.72	-7.1	-5.4
15.08.2024	WB Head	22	156.025	52.0	0.76	48.4	0.72	-6.9	-5.6
15.08.2024	WB Head	22	156.7	52.0	0.76	48.4	0.72	-6.8	-5.6
15.08.2024	WB Head	22	157.425	52.0	0.77	48.4	0.72	-6.8	-5.6

5. TEST PROCEDURE

Testing was carried out in accordance with FCC KDB Publications 447498 D04 Interim General RF Exposure Guidance v01. Test configurations for SAR testing were selected based on conducted power measurements. The DUT was set to transmit at maximum power and continuous duty cycle using test software.

The tested device is push-to-talk, PTT, device hence normal operation mode duty factor of 0.5 is applied. Duty cycle during testing was 100%.

Models V200 and SR303 are included in this test report as they are essentially identical with different branding.

5.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy system.



Device holder supplied by SPEAG

5.2 Test Positions

5.2.1 Body-worn Configuration, 0mm separation distance

Body SAR was tested from the front and back side of the DUT. The device was placed in the SPEAG holder and lifted towards the phantom until the distance between the phantom and the device was 0mm.

Photos of the test positions are presented in appendix A

5.2.2 Extremity Configuration, 0mm separation distance

Extremity SAR was tested from the front, back, left, right and bottom side of the device. The device was placed in the SPEAG holder and lifted towards the phantom until the distance between the phantom and the device was 0mm.

Photos of the test positions are presented in appendix A.

5.3 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.

5.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy 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

DASY8 Uncertainty Budget According to IEC/IEEE 62209-1528 (Frequency band: 4 MHz–300 MHz range)								
Symbol	Error Description	Uncert. value	Prob. Dist.	Div.	(c_1) (1 g)	(c_1) (10 g)	Std. Unc. (1 g)	Std. Unc. (10 g)
Measurement System Errors								
CF	Probe Calibration	$\pm 13.3\%$	N	2	1	1	$\pm 6.65\%$	$\pm 6.65\%$
CF _{drift}	Probe Calibration Drift	$\pm 1.7\%$	R	$\sqrt{3}$	1	1	$\pm 1.0\%$	$\pm 1.0\%$
LIN	Probe Linearity	$\pm 4.7\%$	R	$\sqrt{3}$	1	1	$\pm 2.7\%$	$\pm 2.7\%$
BBS	Broadband Signal	$\pm 0.8\%$	R	$\sqrt{3}$	1	1	$\pm 0.5\%$	$\pm 0.5\%$
ISO	Probe Isotropy	$\pm 7.6\%$	R	$\sqrt{3}$	1	1	$\pm 4.4\%$	$\pm 4.4\%$
DAE	Other Probe+Electronic	$\pm 0.7\%$	N	1	1	1	$\pm 0.7\%$	$\pm 0.7\%$
AMB	RF Ambient	$\pm 1.8\%$	N	1	1	1	$\pm 1.8\%$	$\pm 1.8\%$
Δ_{sys}	Probe Positioning	± 0.006 mm	N	1	0.04	0.04	$\pm 0.10\%$	$\pm 0.10\%$
DAT	Data Processing	$\pm 1.2\%$	N	1	1	1	$\pm 1.2\%$	$\pm 1.2\%$
Phantom and Device Errors								
LIQ(σ)	Conductivity (meas.) ^{DAK}	$\pm 2.5\%$	N	1	0.78	0.71	$\pm 2.0\%$	$\pm 1.8\%$
LIQ(T_σ)	Conductivity (temp.) ^{BB}	$\pm 5.4\%$	R	$\sqrt{3}$	0.78	0.71	$\pm 2.4\%$	$\pm 2.2\%$
EPS	Phantom Permittivity	$\pm 14.0\%$	R	$\sqrt{3}$	0	0	$\pm 0\%$	$\pm 0\%$
DIS	Distance DUT – TSL	$\pm 2.0\%$	N	1	2	2	$\pm 4.0\%$	$\pm 4.0\%$
D _{xyz}	Device Positioning	$\pm 1.0\%$	N	1	1	1	$\pm 1.0\%$	$\pm 1.0\%$
H	Device Holder	$\pm 3.6\%$	N	1	1	1	$\pm 3.6\%$	$\pm 3.6\%$
MOD	DUT Modulation ^m	$\pm 2.4\%$	R	$\sqrt{3}$	1	1	$\pm 1.4\%$	$\pm 1.4\%$
TAS	Time-average SAR	$\pm 1.7\%$	R	$\sqrt{3}$	1	1	$\pm 1.0\%$	$\pm 1.0\%$
RF _{drift}	DUT drift	$\pm 2.5\%$	N	1	1	1	$\pm 2.5\%$	$\pm 2.5\%$
VAL	Val Antenna Unc. ^{val}	$\pm 0.0\%$	N	1	1	1	$\pm 0\%$	$\pm 0\%$
RF _{in}	Unc. Input Power ^{val}	$\pm 0.0\%$	N	1	1	1	$\pm 0\%$	$\pm 0\%$
Correction to the SAR results								
C(ε, σ)	Deviation to Target	$\pm 1.9\%$	N	1	1	0.84	$\pm 1.9\%$	$\pm 1.6\%$
C(R)	SAR scaling ^p	$\pm 0\%$	R	$\sqrt{3}$	1	1	$\pm 0\%$	$\pm 0\%$
u(Δ SAR)	Combined Uncertainty						$\pm 11.4\%$	$\pm 11.2\%$
U	Expanded Uncertainty						$\pm 22.7\%$	$\pm 22.5\%$

7. TEST RESULTS

7.1 SAR Results for Body Exposure Condition with 0mm separation

Band	Channel	Frequency [MHz]	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measured SAR _{10a} [W/kg]	Power Drift [dB]	Measurement Duty Cycle [%]	PTT Duty Cycle [%]	Scaling Factor	Reported SAR _{10a} [W/kg]	Plot #
VHF	14	156.7	36.99	36.8	Front	1.25	-0.01	100	50	0.52	0.65	
VHF	14	156.7	36.99	36.8	Back	1.3	0.02	100	50	0.52	0.68	
VHF	60	156.025	36.99	36.59	Back	1.38	-0.01	100	50	0.55	0.76	3
VHF	88	157.425	36.99	36.61	Back	1.29	0	100	50	0.55	0.70	

7.2 SAR Results for Extremity Condition with 0mm separation

Band	Channel	Frequency [MHz]	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Measured SAR _{10a} [W/kg]	Power Drift [dB]	Measurement Duty Cycle [%]	PTT Duty Cycle [%]	Scaling Factor	Reported SAR _{10a} [W/kg]	Plot #
VHF	14	156.7	36.99	36.8	Front	0.901	-0.01	100	50	0.52	0.47	
VHF	14	156.7	36.99	36.8	Back	0.954	0.02	100	50	0.52	0.50	
VHF	14	156.7	36.99	36.8	Left	1.21	0.03	100	50	0.52	0.63	4
VHF	14	156.7	36.99	36.8	Right	1.11	-0.19	100	50	0.52	0.58	
VHF	14	156.7	36.99	36.8	Bottom	0.768	-0.6*	100	50	0.60	0.46	
VHF	60	156.025	36.99	36.59	Left	1.12	0.07	100	50	0.55	0.61	
VHF	88	157.425	36.99	36.61	Left	1.07	0.01	100	50	0.55	0.58	

*Larger than 5% drifts included to scaling factors

7.3 Zoom Scan Compliance

According to IEC 62209-1528, 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 62209-1528 is automatically verified by DASYS 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.

APPENDIX A: PHOTOS OF THE DUT

Size of the DUT is (including antenna): 279mm x 64mm x 37mm



Figure 3 DUT V200



Figure 4 DUT SR303



Figure 5 DUT in front test position, 0mm separation distance



Figure 6 DUT in back test position, 0mm separation distance



Figure 7 DUT in left test position, 0mm separation distance



Figure 8 DUT in right test position, 0mm separation distance



Figure 9 DUT in bottom test position, 0mm separation distance

APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 2024-08-14, 10:05

Test Laboratory: Verkotan Oy

DUT: CLA-150

Communication System: UID 0, CW; Communication System Band: CLA150; Frequency 150.000 MHz;

Communication System PAR: ;

Medium parameters used: $f = 150.000$; $\sigma = 0.723$ S/m; $\epsilon_r = 48.2$; HSL;

Phantom section: Flat section

Measurement Standard: DASy8 (IEC/IECC)

DASy Configuration:

- Probe: EX3DV4 - SN3852; ConvF(11.14, 11.14, 11.14); Calibrated: 2023-10-23
 - Sensor-Surface: 1.4 mm (VMS + 6p), Mother scan peak deviation; 0.09; Mother scan avg offset: 0.73;
 - Electronics: DAE4ip - SN1774; Calibrated: 2024-06-18
 - Phantom: ELI V8.0 (20deg probe tilt)
 - DASy8 16.2.4.2524

CLA-150, CW, 150 MHz, FRONT, 0.00 mm

Area Scan: Measurement grid: (240.0 mm x 240.0 mm)

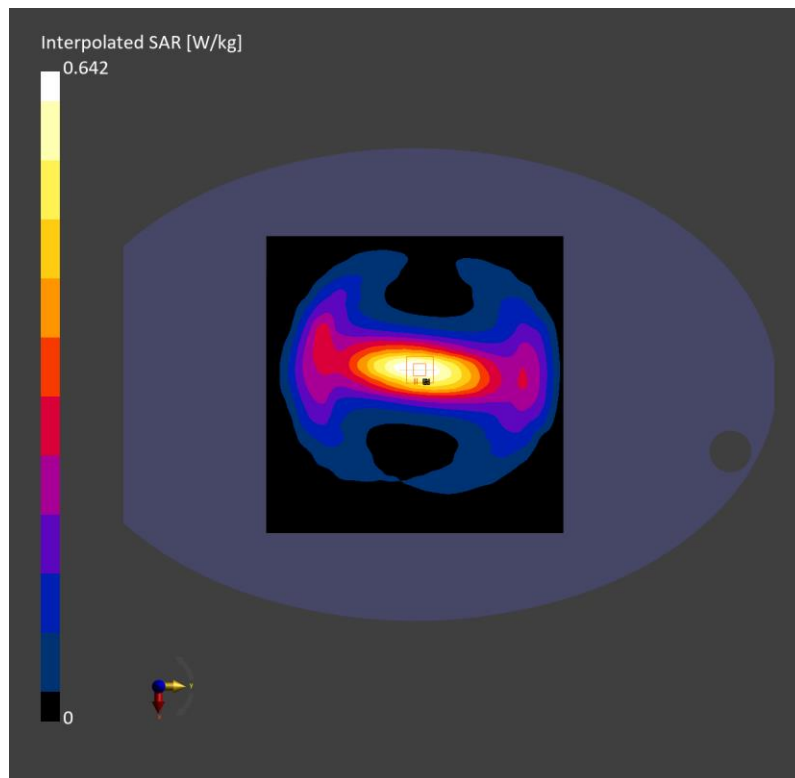
Zoom Scan: Measurement grid: (30.0 mm x 30.0 mm x 30.0 mm)

Reference Value = 0.28 V/m; Power Drift = -0.00 dB

SAR(1 g) = 0.355 W/kg; SAR(10g) = 0.238 W/kg (Positive / Negative)

Smallest distance from peaks to all points 3dB below = > 15.0 mm

Ratio of SAR at M2 to SAR at M1 = 78.2%



Date/Time: 2024-08-15, 09:04

Test Laboratory: Verkotan Oy

DUT: CLA-150

Communication System: UID 0, CW; Communication System Band: CLA150; Frequency 150.000 MHz;

Communication System PAR: ;

Medium parameters used: $f = 150.000$; $\sigma = 0.719$ S/m; $\epsilon_r = 48.6$; HSL;

Phantom section: Flat section

Measurement Standard: DASy8 (IEC/IECC)

DASy Configuration:

- Probe: EX3DV4 - SN3852; ConvF(11.14, 11.14, 11.14); Calibrated: 2023-10-23
 - Sensor-Surface: 1.4 mm (VMS + 6p), Mother scan peak deviation; 0.08; Mother scan avg offset: 0.61;
 - Electronics: DAE4ip - SN1774; Calibrated: 2024-06-18
 - Phantom: ELI V8.0 (20deg probe tilt)
 - DASy8 16.2.4.2524

CLA-150, CW, 150 MHz, FRONT, 0.00 mm

Area Scan: Measurement grid: (40.0 mm x 90.0 mm)

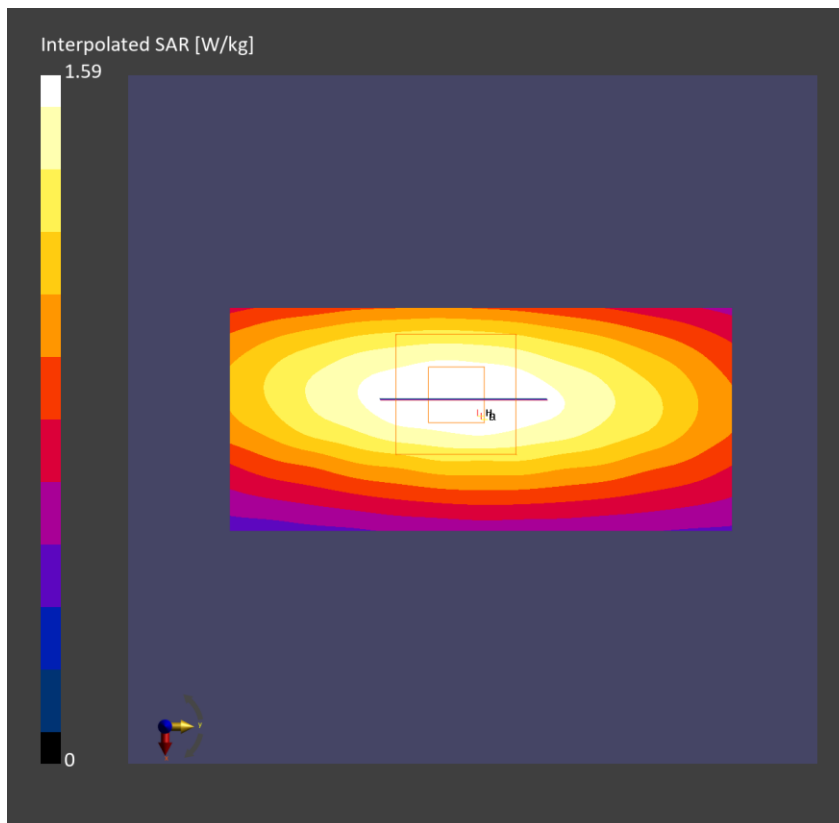
Zoom Scan: Measurement grid: (30.0 mm x 30.0 mm x 30.0 mm)

Reference Value = 0.71 V/m; Power Drift = 0.00 dB

SAR(1 g) = 0.890 W/kg; SAR(10g) = 0.597 W/kg (Positive / Negative)

Smallest distance from peaks to all points 3dB below = > 15.0 mm

Ratio of SAR at M2 to SAR at M1 = 78.1%



APPENDIX C: MEASUREMENT SCANS

Plot 3

Date/Time: 2024-08-15, 15:06
Test Laboratory: Verkotan Oy

DUT: V200/SR303

Communication System: UID 0, CW; Communication System Band: Custom Band; Frequency 156.000 MHz;
Communication System PAR: ;
Medium parameters used: $f = 156.000$; $\sigma = 0.722$ S/m; $\epsilon_r = 48.4$; HSL;
Phantom section: Flat section
Measurement Standard: DASy8 (IEC/IECC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(11.14, 11.14, 11.14); Calibrated: 2023-10-23
 - Sensor-Surface: 1.4 mm (VMS + 6p), Mother scan peak deviation: 0.07; Mother scan avg offset: 0.92;
 - Electronics: DAE4ip - SN1774; Calibrated: 2024-06-18
 - Phantom: ELI V8.0 (20deg probe tilt)
 - DASy8 16.2.4.2524

Custom Band, CW, CH156000, BACK, 0.00 mm

Area Scan: Measurement grid: (120.0 mm x 480.0 mm)

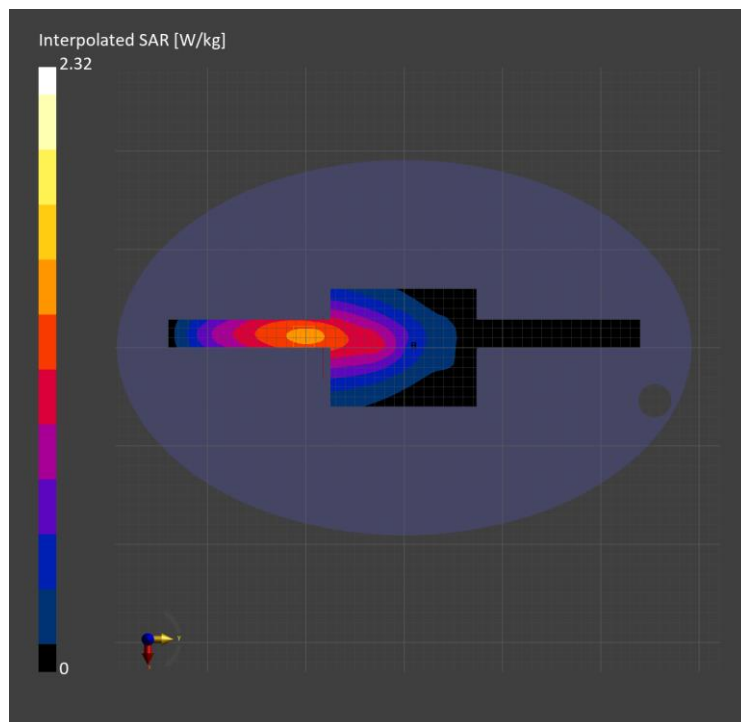
Zoom Scan: Measurement grid: (30.0 mm x 30.0 mm x 30.0 mm)

Reference Value = 1.13 W/kg; Power Drift = 0.02 dB

SAR(1 g) = 1.38 W/kg; SAR(10g) = 1.02 W/kg (Positive only)

Smallest distance from peaks to all points 3dB below = > 15.0 mm

Ratio of SAR at M2 to SAR at M1 = 79.4%



Date/Time: 2024-08-14, 15:16

Test Laboratory: Verkotan Oy

DUT: V200/SR303

Communication System: UID 0, CW; Communication System Band: Custom Band; Frequency 156.700 MHz;

Communication System PAR: ;

Medium parameters used: $f = 156.700$; $\sigma = 0.726$ S/m; $\epsilon_r = 48.0$; HSL;

Phantom section: Flat section

Measurement Standard: DASy8 (IEC/IECC)

DASy Configuration:

- Probe: EX3DV4 - SN3852; ConvF(11.14, 11.14, 11.14); Calibrated: 2023-10-23
 - Sensor-Surface: 1.4 mm (VMS + 6p), Mother scan peak deviation: 0.05; Mother scan avg offset: 0.68;
 - Electronics: DAE4ip - SN1774; Calibrated: 2024-06-18
 - Phantom: ELI V8.0 (20deg probe tilt)
 - DASy8 16.2.4.2524

Custom Band, CW, CH156700, EDGE LEFT, 0.00 mm

Area Scan: Measurement grid: (90.0 mm x 480.0 mm)

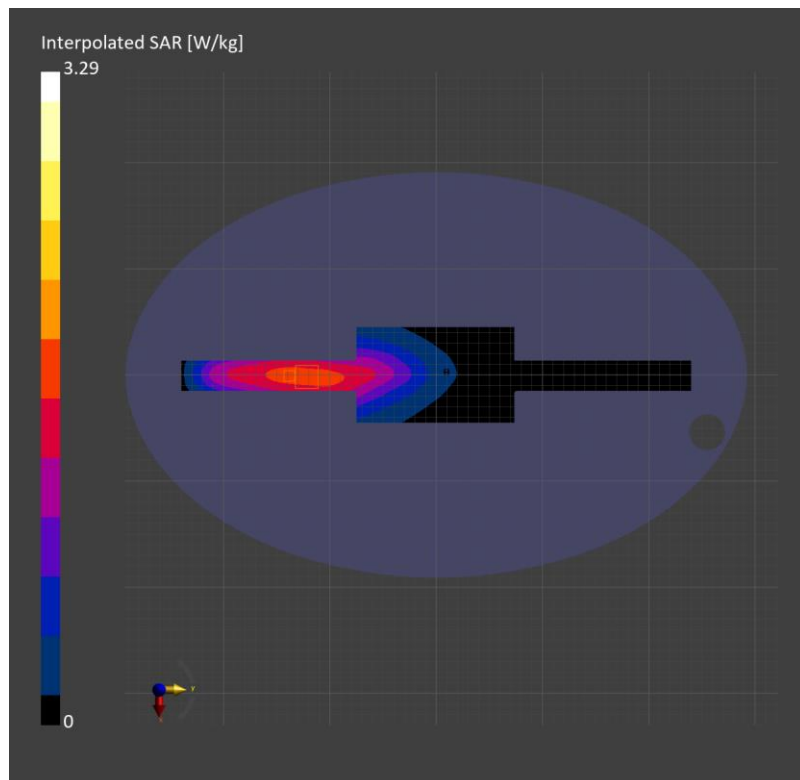
Zoom Scan: Measurement grid: (30.0 mm x 30.0 mm x 30.0 mm)

Reference Value = 1.38 V/m; Power Drift = 0.01 dB

SAR(1 g) = 1.69 W/kg; SAR(10g) = 1.21 W/kg (Positive)

Smallest distance from peaks to all points 3dB below = > 15.0 mm

Ratio of SAR at M2 to SAR at M1 = 65.2%



APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS

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



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Accreditation No.: **SCS 0108**

Client **Verkotan**
Oulu, Finland

Certificate No. **EX-3852_Oct23**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3852**

Calibration procedure(s) **QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6,
QA CAL-25.v8
Calibration procedure for dosimetric E-field probes**

Calibration date **October 23, 2023**

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 NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-291	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
OCF DAK-3.5 (weighted)	SN: 1249	05-Oct-23 (OCF-DAK3.5-1249_Oct23)	Oct-24
OCF DAK-12	SN: 1016	05-Oct-23 (OCF-DAK12-1016_Oct23)	Oct-24
Reference 20 dB Attenuator	SN: CC2552 (20x)	30-Mar-23 (No. 217-03809)	Mar-24
DAE4	SN: 660	16-Mar-23 (No. DAE4-660_Mar23)	Mar-24
Reference Probe ES3DV2	SN: 3013	06-Jan-23 (No. ES3-3013_Jan23)	Jan-24

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: MY41498067	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 8649C	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	Johanna Lieshaj	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	
			Issued: October 23, 2023

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EX3DV4 - SN:3852

October 23, 2023

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	0.42	0.40	0.47	$\pm 10.1\%$
DCP (mV) ^B	102.6	101.5	101.2	$\pm 4.7\%$

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
D	CW	X	0.00	0.00	1.00	0.00	148.1	$\pm 1.2\%$	$\pm 4.7\%$
		Y	0.00	0.00	1.00		135.0		
		Z	0.00	0.00	1.00		125.7		
10352	Pulse Waveform (200Hz, 10%)	X	20.00	88.23	18.81	10.00	60.0	$\pm 2.9\%$	$\pm 9.6\%$
		Y	15.83	85.04	18.58		60.0		
		Z	20.00	89.60	19.58		60.0		
10353	Pulse Waveform (200Hz, 20%)	X	20.00	89.81	18.49	6.99	80.0	$\pm 1.6\%$	$\pm 9.6\%$
		Y	20.00	89.05	18.11		80.0		
		Z	20.00	91.94	19.69		80.0		
10354	Pulse Waveform (200Hz, 40%)	X	20.00	94.09	19.25	3.98	95.0	$\pm 1.2\%$	$\pm 9.6\%$
		Y	20.00	88.35	16.15		95.0		
		Z	20.00	93.97	19.35		95.0		
10355	Pulse Waveform (200Hz, 60%)	X	20.00	100.39	20.91	2.22	120.0	$\pm 1.2\%$	$\pm 9.6\%$
		Y	2.38	71.76	9.70		120.0		
		Z	20.00	97.37	19.68		120.0		
10387	QPSK Waveform, 1 MHz	X	1.64	66.74	15.13	1.00	150.0	$\pm 2.8\%$	$\pm 9.6\%$
		Y	1.57	65.66	14.38		150.0		
		Z	1.68	66.38	15.01		150.0		
10388	QPSK Waveform, 10 MHz	X	2.18	68.09	15.84	0.00	150.0	$\pm 0.9\%$	$\pm 9.6\%$
		Y	2.13	67.56	15.26		150.0		
		Z	2.26	68.28	15.80		150.0		
10396	64-QAM Waveform, 100 kHz	X	2.80	70.45	18.83	3.01	150.0	$\pm 0.7\%$	$\pm 9.6\%$
		Y	2.67	68.53	17.69		150.0		
		Z	2.75	69.32	18.17		150.0		
10399	64-QAM Waveform, 40 MHz	X	3.46	67.10	15.80	0.00	150.0	$\pm 2.2\%$	$\pm 9.6\%$
		Y	3.46	66.99	15.61		150.0		
		Z	3.55	67.36	15.87		150.0		
10414	WLAN CCDF, 64-QAM, 40 MHz	X	4.78	65.85	15.56	0.00	150.0	$\pm 4.1\%$	$\pm 9.6\%$
		Y	4.86	65.73	15.56		150.0		
		Z	4.73	65.20	15.31		150.0		

Note: For details on UID parameters see Appendix

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

^A The uncertainties of Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Page 5).

^B Uncertainty 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 23, 2023

Parameters of Probe: EX3DV4 - SN:3852

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $ms V^{-2}$	T2 $ms V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
x	40.1	298.39	35.39	12.42	0.00	5.06	1.30	0.18	1.01
y	45.2	342.83	36.51	8.80	0.45	5.06	0.00	0.49	1.01
z	44.9	336.32	35.73	13.60	0.00	5.08	0.53	0.35	1.01

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	-56.9°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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

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Parameters of Probe: EX3DV4 - SN:3852

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k = 2)
6	55.0	0.75	14.87	14.87	14.87	0.00	1.25	±13.3%
13	55.0	0.75	13.94	13.94	13.94	0.00	1.25	±13.3%
30	55.0	0.75	12.97	12.97	12.97	0.00	1.25	±13.3%
64	54.2	0.75	11.54	11.54	11.54	0.00	1.25	±13.3%
128	52.8	0.76	11.14	11.14	11.14	0.00	1.25	±13.3%
220	49.0	0.81	10.56	10.56	10.56	0.00	1.25	±13.3%
450	43.5	0.87	9.99	9.99	9.99	0.16	1.30	±13.3%
1300	40.8	1.14	8.19	7.92	8.28	0.48	1.27	±12.0%
1450	40.5	1.20	8.04	7.77	8.01	0.46	1.27	±12.0%
1640	40.2	1.31	8.04	7.69	8.00	0.43	1.27	±12.0%
1810	40.0	1.40	7.69	7.64	7.66	0.28	1.27	±12.0%
1900	40.0	1.40	7.75	7.66	7.73	0.28	1.27	±12.0%
2450	39.2	1.80	7.07	7.09	7.16	0.31	1.27	±12.0%
3300	38.2	2.71	6.76	6.56	6.80	0.32	1.27	±14.0%
3500	37.9	2.91	6.75	6.56	6.76	0.33	1.27	±14.0%
3700	37.7	3.12	6.56	6.40	6.58	0.34	1.27	±14.0%
3900	37.5	3.32	6.52	6.37	6.54	0.34	1.27	±14.0%
4100	37.2	3.53	6.23	6.14	6.27	0.35	1.27	±14.0%
5250	35.9	4.71	4.99	4.95	5.05	0.37	1.53	±14.0%
5600	35.5	5.07	4.54	4.50	4.60	0.37	1.75	±14.0%
5750	35.4	5.22	4.62	4.57	4.67	0.38	1.84	±14.0%

^C Frequency validity above 300 MHz of ±100 MHz only applies for DAS7 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 4–8 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10%. If TSL with deviations from the target of less than ±5% are used, the calibration uncertainties are 11.1% for 0.7–3 GHz and 13.1% for 3–6 GHz.

^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

**Calibration Laboratory of
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Accreditation No.: **SCS 0108**

Certificate No: **CLA150-4027_Jul22**

CALIBRATION CERTIFICATE

Object: **CLA150 - SN: 4027**

Calibration procedure(s): **QA CAL-15.v9
Calibration Procedure for SAR Validation Sources below 700 MHz**

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: 104776	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: CG2552 (20x)	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: 3877	31-Dec-21 (No. EX3-3877_Dec21)	Dec-22
DAE4	SN: 654	26-Jan-22 (No. DAE4-654_Jan22)	Jan-23

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 Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:

Approved by:

Name: **Aldona Georgiadou**

Name: **Niels Kuster**

Function: **Laboratory Technician**

Function: **Quality Manager**

Signature: 

Signature: 

Issued: July 20, 2022

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Certificate No: CLA150-4027_Jul22

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Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	$dx, dy = 4.0$ mm, $dz = 1.4$ mm	Graded Ratio = 1.4 (Z direction)
Frequency	150 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	$50.7 \pm 6 \%$	$0.75 \text{ mho/m} \pm 6 \%$
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	1 W input power	3.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	$3.63 \text{ W/kg} \pm 18.4 \%$ (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	$2.44 \text{ W/kg} \pm 18.0 \%$ (k=2)