SAR Compliance Test Report

Date of Report	8/06/2021	**Client's Contact person:**	Tero Ihalainen
Number of pages:	48	**Responsible Test engineer:**	Jesper Varis
Testing laboratory:	**Verkotan Oy** Elektroniikkatie 17 90590 Oulu Finland	**Client:**	**Navigil Ltd** Karaportti 5 02610 Espoo Finland
Tested device	Navigil 580 Wristwatch		
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** **RSS-102, Issue 5** 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:	08.06.2021 Miia Nurkkala Digitaalinen allekirjoittaja: Miia Nurkkala Päiväys: 2021.06.08 09:33:12 +03'00' **Laboratory Manager**		

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (DUT):

Product:	Navigil 580 Wristwatch
Manufacturer:	Navigil Ltd
Model:	Navigil 580
IMEI Number:	351521100447440
FCC ID Number:	Contains HSW-TY1SC
ISED ID Number:	Contains 4492A-TY1SC
Hardware Version:	C
DUT Number:	22014, 22016
Battery Type used in testing:	Integrated
State of the Sample:	Production sample

Testing information:

Testing performed	11.5.2021, 14.5.2021 – 19.5.2021
Notes	-
Document ID	FCC_ISED SAR report_Navigil 580 _ID4592_08062021
Document history	Initial version
Temperature °C	22±2 / Controlled
Humidity RH%	30±20 / Controlled
Measurement performed by	Jesper Varis
FCC Test Firm Designation Number	FI00005
ISED Company Number	22218

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1.2 Maximum Results

The maximum reported* SAR values for extremity and next to the mouth exposure condition. The device conforms to the requirements of the standards when the maximum reported SAR value is less than or equal to the limit. The SAR limit specified in FCC 47 CFR part 2 (2.1093) and in Health Canada's RF exposure guideline; Safety Code 6 is SAR_{10g} of 4.0 W/kg for extremities and SAR_{1g} of 1.6 W/kg for body.

1.2.1 Standalone SAR

System	Highest Reported* SAR_{10g}(W/kg) in Extremity Exposure Condition, 0mm separation distance	Highest Reported* SAR_{1g}(W/kg) in Next to the Mouth Condition, 10mm separation distance	Result
LTE-M1, Band 2	**1.11**	**0.93**	**PASS**
LTE-M1, Band 4	**0.99**	**1.00**	**PASS**
LTE-M1, Band 12	**0.31**	**0.06**	**PASS**

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

1.2.2 Maximum Drift

Maximum Drift During Measurements	0.48dBm*

*Larger than 5% drifts included to scaling factors

1.2.3 Measurement Uncertainty

Expanded Uncertainty (k=2) 95 %	±23.4 %

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2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is a smart wristwatch with LTE Cat M1 module, GPS, activity and vital signs monitoring and wireless beacon features. The DUT supports BLE. BLE is supported only in receiver mode thus SAR measurement is not needed.

Device Category	Portable
Exposure Environment	General population uncontrolled

2.1 Supported Frequency Bands and Operational Modes

	Modes of Operation	**Transmitter Frequency Range (MHz)**
TX Frequency bands	LTE-M1, Band 2	1850-1910
	LTE-M1, Band 4	1710-1755
	LTE-M1, Band 12	699-716

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3. OUTPUT POWER

3.1 Maximum specified conducted output power

From the customer, including tune-up tolerance.

LTE-M1	Max Output Power [dBm]
LTE-M1 2	23
LTE-M1 4	23
LTE-M1 12	23

3.2 Tested conducted power

Measured conducted output power [dBm];

LTE Band / BW	RB Size RBs	RB Offset 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	22.52	22.52	22.79	0	22.02	21.6	21.54	1
	1	2	22.77	22.76	22.94	0	21.94	21.72	22.46	1
	1	5	22.61	22.6	22.71	0	21.89	21.53	21.45	1
	3	0	21.7	21.68	21.5	1	20.93	20.65	20.95	2
	3	1	21.72	21.74	21.47	1	20.84	20.69	20.91	2
	3	3	21.6	21.59	21.45	1	21.05	20.51	20.96	2
	6	0	21.03	21.04	20.73	2	20.46	20.93	20.61	2

LTE Band / BW	RB Size RBs	RB Offset 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	22.58	22.73	22.62	0	21.7	21.7	21.52	1
	1	2	22.88	22.91	23.24	0	21.91	22.5	21.57	1
	1	5	22.65	22.7	22.53	0	21.74	21.64	21.55	1
	3	0	21.72	21.75	21.84	1	20.82	20.84	20.91	2
	3	1	21.77	21.62	21.67	1	20.91	20.89	20.75	2
	3	3	21.63	21.52	21.82	1	20.73	20.83	20.92	2
	6	0	20.8	20.74	20.71	2	20.68	20.68	20.52	2

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LTE Band / BW	RB Size RBs	RB Offset 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	22.62	22.69	22.8	0	22.85	22.72	22.62	0
	1	2	22.87	23.12	23.34	0	23.13	23.76	22.73	0
	1	5	22.65	22.75	22.74	0	22.83	22.71	22.69	0
	3	0	21.74	21.83	21.94	1	22.26	21.98	22.03	1
	3	1	21.61	21.67	21.74	1	22.55	21.85	21.86	1
	3	3	21.74	21.67	21.73	1	22.22	21.85	22.01	1
	6	0	21.87	21.85	21.78	1	20.95	20.98	20.69	2

LTE Band / BW	RB Size RBs	RB Offset 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	22.61	22.66	22.82	0	22.88	22.59	22.66	0
	1	2	22.88	23.1	23.32	0	23.14	23.65	22.79	0
	1	5	22.67	22.69	22.75	0	22.87	22.57	22.71	0
	3	0	22.76	22.77	22.9	0	23.17	22.93	22.93	0
	3	1	22.58	22.67	22.77	0	23.47	22.66	22.8	0
	3	3	22.79	22.62	22.73	0	23.16	22.77	22.93	0
	6	0	21.82	21.81	21.8	1	20.99	21.03	20.77	2

LTE Band / BW	RB Size RBs	RB Offset 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	22.56	22.51	22.68	0	22.92	22.89	22.76	0
	1	2	22.81	22.78	23.12	0	23.0	23.1	23.77	0
	1	5	22.59	22.55	22.74	0	22.87	22.89	22.74	0
	3	0	22.59	22.59	22.85	0	22.84	22.99	22.98	0
	3	1	22.5	22.48	22.7	0	22.67	23.26	22.79	0
	3	3	22.64	22.62	22.66	0	22.72	22.96	22.84	0
	6	0	22.79	22.76	22.8	0	22.67	22.82	22.97	0

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LTE Band / BW	RB Size RBs	RB Offset 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	22.59	22.62	22.74	0	22.92	22.65	22.67	0
	1	2	22.87	23.05	23.44	0	23.16	23.76	22.82	0
	1	5	22.65	22.67	22.73	0	22.94	22.68	22.72	0
	3	0	22.72	22.67	22.9	0	23.06	22.86	22.99	0
	3	1	22.54	22.56	22.81	0	23.35	22.73	22.85	0
	3	3	22.74	22.54	22.74	0	23.03	22.73	22.99	0
	6	0	22.8	22.71	22.78	0	22.89	22.86	22.59	0

LTE Band / BW	RB Size RBs	RB Offset 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	22.43	22.87	22.45	0	21.5	21.43	21.19	1
	1	2	22.58	22.9	22.92	0	21.59	22.39	21.41	1
	1	5	22.49	22.7	22.59	0	21.42	21.52	21.34	1
	3	0	21.52	21.2	22.0	1	20.4	20.69	20.7	2
	3	1	21.53	21.04	21.92	1	20.39	20.63	20.6	2
	3	3	21.42	21.16	21.81	1	20.24	20.69	20.73	2
	6	0	20.8	20.52	20.52	2	20.67	20.37	20.24	2

LTE Band / BW	RB Size RBs	RB Offset 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	22.55	22.6	22.43	0	21.69	21.64	21.59	1
	1	2	22.78	22.76	23.02	0	21.87	22.56	21.6	1
	1	5	22.57	22.5	22.53	0	21.77	21.6	21.54	1
	3	0	21.56	21.42	21.83	1	20.75	20.69	20.72	2
	3	1	21.61	21.25	21.61	1	20.8	20.73	20.6	2
	3	3	21.45	21.16	21.72	1	20.57	20.66	20.74	2
	6	0	20.62	20.57	20.55	2	20.58	20.51	20.32	2

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LTE Band / BW	RB Size RBs	RB Offset 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	22.59	22.64	22.54	0	22.85	22.79	22.63	0
	1	2	22.77	23.05	23.22	0	23.12	23.93	22.74	0
	1	5	22.57	22.64	22.61	0	22.82	22.9	22.67	0
	3	0	21.63	21.55	21.84	1	22.03	21.8	22.05	1
	3	1	21.48	21.41	21.68	1	22.28	21.5	21.82	1
	3	3	21.61	21.4	21.66	1	22.21	21.71	22.01	1
	6	0	21.68	21.73	21.58	1	20.69	20.89	20.56	2

LTE Band / BW	RB Size RBs	RB Offset 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	22.61	22.62	22.59	0	22.91	22.77	22.58	0
	1	2	22.79	23.04	23.21	0	23.18	23.94	22.73	0
	1	5	22.6	22.62	22.72	0	22.92	22.88	22.61	0
	3	0	22.6	22.47	22.89	0	22.98	22.8	23.04	0
	3	1	22.43	22.38	22.61	0	23.17	22.49	22.89	0
	3	3	22.61	22.39	22.69	0	22.94	22.69	23.07	0
	6	0	21.7	21.72	21.58	1	20.83	20.91	20.46	2

LTE Band / BW	RB Size RBs	RB Offset 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	22.57	22.62	22.58	0	22.86	22.79	22.73	0
	1	2	22.78	23.01	23.22	0	23.11	23.92	22.8	0
	1	5	22.56	22.63	22.69	0	22.83	22.91	22.75	0
	3	0	22.62	22.56	22.85	0	23.03	22.79	22.99	0
	3	1	22.46	22.41	22.61	0	23.36	22.52	22.78	0
	3	3	22.57	22.39	22.7	0	23.18	22.75	22.9	0
	6	0	22.73	22.7	22.6	0	22.68	22.78	22.47	0

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LTE Band / BW	RB Size RBs	RB Offset 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	22.61	22.63	22.55	0	22.89	22.72	22.6	0
	1	2	22.77	23.04	23.24	0	23.16	23.91	22.72	0
	1	5	22.59	22.65	22.64	0	22.89	22.85	22.64	0
	3	0	22.59	22.56	22.91	0	22.98	22.75	23.08	0
	3	1	22.42	22.43	22.62	0	23.29	22.36	22.88	0
	3	3	22.59	22.43	22.71	0	23.08	22.66	23.06	0
	6	0	22.72	22.72	22.63	0	22.76	22.86	22.39	0

LTE Band / BW	RB Size RBs	RB Offset 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	19.14	19.87	19.94	0	18.03	18.88	19.31	1
	1	2	19.47	19.99	20.04	0	18.2	19.27	19.29	1
	1	5	19.18	19.86	19.97	0	18.13	19.0	19.25	1
	3	0	18.34	18.61	18.69	1	17.45	17.89	18.17	2
	3	1	18.46	18.63	18.72	1	17.32	17.93	18.1	2
	3	3	18.24	18.42	18.53	1	17.48	17.81	18.25	2
	6	0	17.37	18.08	18.18	2	17.04	17.67	17.72	2

LTE Band / BW	RB Size RBs	RB Offset 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	19.23	19.8	19.85	0	18.45	18.96	18.92	1
	1	2	19.59	20.39	20.18	0	19.44	19.12	19.0	1
	1	5	19.29	19.8	19.82	0	18.39	18.98	18.96	1
	3	0	18.39	18.98	19.05	1	17.44	18.0	18.06	2
	3	1	18.4	18.82	19.07	1	17.48	17.91	17.91	2
	3	3	18.29	18.99	18.89	1	17.41	18.0	18.05	2
	6	0	17.31	17.78	18.0	2	17.36	17.95	17.73	2

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LTE Band / BW	RB Size RBs	RB Offset 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	19.23	19.76	19.96	0	19.63	19.95	19.98	0
	1	2	19.54	20.29	20.61	0	19.91	21.15	20.13	0
	1	5	19.28	19.78	19.89	0	19.65	20.0	20.11	0
	3	0	18.4	18.97	19.22	1	18.67	19.08	19.32	1
	3	1	18.23	18.82	19.07	1	18.85	18.92	19.14	1
	3	3	18.42	18.81	19.03	1	18.59	18.99	19.29	1
	6	0	18.41	18.98	19.02	1	17.53	18.08	17.91	2

LTE Band / BW	RB Size RBs	RB Offset 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	19.29	19.71	19.97	0	19.68	19.85	20.01	0
	1	2	19.57	20.19	20.64	0	19.97	21.08	20.13	0
	1	5	19.33	19.75	19.96	0	19.72	19.86	20.06	0
	3	0	19.42	19.85	20.14	0	19.63	20.01	20.27	0
	3	1	19.24	19.69	20.12	0	19.88	19.72	20.15	0
	3	3	19.44	19.7	19.97	0	19.61	19.87	20.29	0
	6	0	18.47	18.88	19.01	1	17.57	18.04	17.87	2

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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.

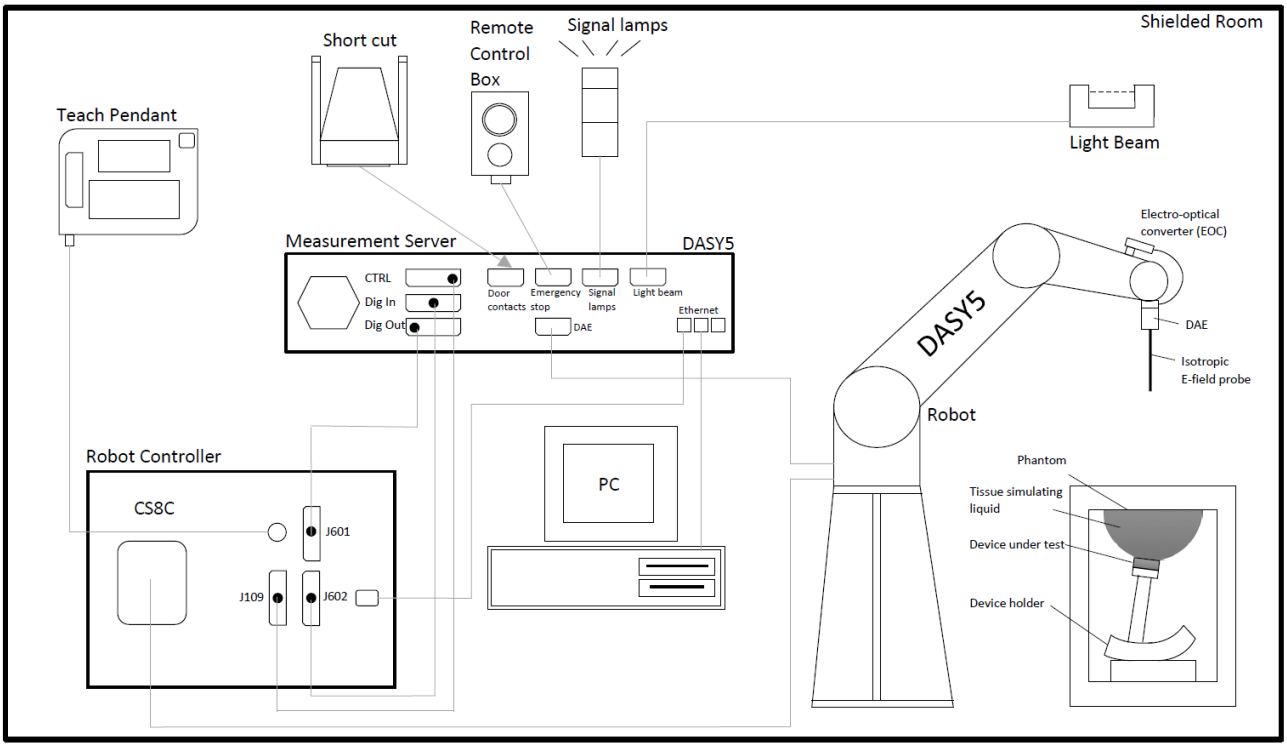

Figure 1 Schematic Laboratory Picture

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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	710	03.2021
Probe	EX3DV4	7447	03.2021
Dipole	D750V3	42/17 DIP 0G750-454	12.2018
Dipole	D1800V2	2d075	12.2020
Dipole	D1900V2	511	3.2020
DASY5 Software	52.8.8.1258	-	NA
Signal generator	R&S SMIQ 06B	1125.5555.06	NA
Amplifier	AR	10S1G4A	NA
Power Reflection Meter	NRT	835065/049	02.2021
Directional Power Sensor	NRT-Z44	835374/021	02.2021
Radio Communication Tester	R&S CMW500	1201.002K50-159661-pb	03.2021

Dipole calibration period supporting data:

		Measured on 09/2020			Calibrated		
Dipole and serial number	Frequency (MHz)	Return loss (dB)	Impedance (Ω)		Return loss (dB)	Impedance (Ω)	
42/17 DIP 0G750-454	750	-22.8	52.9	-6.9	-27.76	52.5	-3.3

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 µW/g to > 100 W/kg, 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

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4.2 Phantoms

Modular Flat Phantom (MFP)

The Triple Modular Phantom consists of three identical modules that can be installed and removed separately without emptying the liquid. It is used for compliance testing of small wireless devices in next to the mouth configurations. 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 ±10% of the recommended values. 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
750	D750V3 - SN: 454	EX3DV4 - SN: 7447	CW	DAE 4 / 710	42.55	0.92	04/2021
1800	D1800V2-SN:2D075	EX3DV4 - SN: 7447	CW	DAE 4 / 710	37.87	1.32	04/2021
1900	D1900V2-SN:5D004	EX3DV4 - SN: 7447	CW	DAE 4 / 710	37.37	1.36	04/2021

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 #
10.5.2021	WB HEAD	22±2	1900	250mW	9.66	37.1	38.64	4.15	1
14.5.2021	WB HEAD	22±2	1900	250mW	9.56	37.1	38.24	3.07	2
17.5.2021	WB HEAD	22±2	750	250mW	1.98	8.52	7.92	-7.04	3
17.5.2021	WB HEAD	22±2	1800	250mW	9.81	39.44	39.24	-0.51	4
17.5.2021	WB HEAD	22±2	1900	250mW	9.78	37.1	39.12	5.4	

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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 (%)**
10.05.2021	WB Head	22	1900	40	1.4	37.28	1.47	-6.8	4.8
14.05.2021	WB Head	22	1860	40	1.4	37.37	1.44	-6.6	2.5
14.05.2021	WB Head	22	1880	40	1.4	37.34	1.45	-6.7	3.3
14.05.2021	WB Head	22	1900	40	1.4	37.31	1.46	-6.7	4.1
17.05.2021	WB Head	22	704	42.18	0.89	39.56	0.9	-6.2	1.6
17.05.2021	WB Head	22	707.5	42.16	0.89	39.55	0.91	-6.2	1.7
17.05.2021	WB Head	22	711	42.14	0.89	39.55	0.91	-6.2	1.8
17.05.2021	WB Head	22	750	41.94	0.89	39.43	0.92	-6.0	2.9
17.05.2021	WB Head	22	1720	40.13	1.35	37.46	1.35	-6.6	-0.5
17.05.2021	WB Head	22	1732.5	40.11	1.36	37.44	1.35	-6.7	-0.5
17.05.2021	WB Head	22	1745	40.09	1.37	37.42	1.36	-6.7	-0.5
17.05.2021	WB Head	22	1800	40	1.4	37.36	1.39	-6.6	-0.6
17.05.2021	WB Head	22	1860	40	1.4	37.26	1.43	-6.9	1.9
17.05.2021	WB Head	22	1880	40	1.4	37.24	1.44	-6.9	2.7
17.05.2021	WB Head	22	1900	40	1.4	37.21	1.45	-7.0	3.6

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5. TEST PROCEDURE

Testing was carried out in accordance with FCC KDB Publication 447498 D01. KDB 941225 D05 was used to select LTE test modes for testing.

The DUT was set to transmit with full power by using communication tester for cellular technologies.

According to manufacturer under absolute worst case conditions maximum duty cycle of the DUT may be up to 75%. The scenario is from a very unlikely situation where the module is continuously trying to send UPD packets and is in the cell edge without no other cell to switch to. Due to battery consumption reasons, SAR testing was conducted using a duty cycle of 33%. The measured SAR values were scaled to 75% duty cycle leading into conservative reported SAR values.

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

Photos of the test positions are presented in appendix A.

5.2.1 Next to the Mouth Configuration,10mm separation distance

The device was placed on the top of the Rohacell the front (display) 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 10mm.

This test position covers both next to the mouth and in front of the face use cases.

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5.2.2 Extremity Exposure Configuration, 0mm separation distance

The device was placed on the top of the Rohacell and lifted towards the phantom until the distance between the phantom and DUT was 0mm. Back side of the DUT and button sides (right, bottom) that may be directly in contact with limbs were tested.

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 Dasy52 are all based on the modified Quadratic Shepard's method (Robert J. Renka," Multivariate Interpolation of Large Sets of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).
The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighboring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.
In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

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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_i) 1g	(c_i) 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_σ)	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%

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7. TEST RESULTS

7.1 SAR Results for Limb Exposure Condition, with 0mm separation

Band	Channel	Modulation/ BW [MHz]	RB Size	RB Offset	Test Position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR10g [W/kg]	Power Drift [dB]	Scaling Factor	Test Duty Cycle [%]	Max Duty Cycle [%]	Reported SAR 10g [W/kg]	Plot #
LTE-M1 2	19100	QPSK/20	1	2	Back	23	23.44	0.399	0.13	1.00	33	75	0.91	
LTE-M1 2	19100	QPSK/20	3	0	Back	23	22.9	0.402	0.11	1.02	33	75	0.93	
LTE-M1 2	19100	QPSK/20	1	2	Right	23	23.44	0.167	-0.02	1.00	33	75	0.38	
LTE-M1 2	19100	QPSK/20	3	0	Right	23	22.9	0.161	0.1	1.02	33	75	0.37	
LTE-M1 2	19100	QPSK/20	1	2	Bottom	23	23.44	0.07	0.3	1.07	33	75	0.17	
LTE-M1 2	19100	QPSK/20	3	0	Bottom	23	22.9	0.0673	0.23	1.08	33	75	0.17	
LTE-M1 2	18700	QPSK/20	1	2	Back	23	22.87	0.475	-0.15	1.03	33	75	1.11	5
LTE-M1 2	18900	QPSK/20	1	2	Back	23	23.05	0.42	0.04	1.00	33	75	0.95	
LTE-M1 2	18700	QPSK/20	3	3	Back	23	22.74	0.451	0.08	1.06	33	75	1.09	
LTE-M1 2	18900	QPSK/20	3	0	Back	23	22.67	0.404	0.09	1.08	33	75	0.99	

*Larger than 5% drifts included to scaling factor

Band	Channel	Modulation/ BW [MHz]	RB Size	RB Offset	Test Position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR10g [W/kg]	Power Drift [dB]	Scaling Factor	Test Duty Cycle [%]	Max Duty Cycle [%]	Reported SAR 10g [W/kg]	Plot #
LTE-M1 4	20300	QPSK/20	1	2	Back	23	23.24	0.415	0.22	1.05	33	75	0.99	6
LTE-M1 4	20300	QPSK/20	3	0	Back	23	22.91	0.415	-0.01	1.02	33	75	0.96	
LTE-M1 4	20300	QPSK/20	1	2	Right	23	23.24	0.0953	0.1	1.00	33	75	0.22	
LTE-M1 4	20300	QPSK/20	3	0	Right	23	22.91	0.089	-0.04	1.02	33	75	0.21	
LTE-M1 4	20300	QPSK/20	1	2	Bottom	23	23.24	0.0803	0.25	1.06	33	75	0.19	
LTE-M1 4	20300	QPSK/20	3	0	Bottom	23	22.91	0.0868	0.02	1.02	33	75	0.20	
LTE-M1 4	20050	QPSK/20	1	2	Back	23	22.77	0.32	0.11	1.05	33	75	0.77	
LTE-M1 4	20175	QPSK/20	1	2	Back	23	23.04	0.361	0.17	1.00	33	75	0.82	
LTE-M1 4	20050	QPSK/20	3	0	Back	23	22.59	0.326	0.2	1.10	33	75	0.81	
LTE-M1 4	20175	QPSK/20	3	0	Back	23	22.56	0.336	0.21	1.11	33	75	0.85	

*Larger than 5% drifts included to scaling factor

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Band	Channel	Modulation/ BW [MHz]	RB Size	RB Offset	Test Position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR10g [W/kg]	Power Drift [dB]	Scaling Factor	Test Duty Cycle [%]	Max Duty Cycle [%]	Reported SAR 10g [W/kg]	Plot #
LTE-M1 12	23130	QPSK/10	1	2	Back	23	20.64	0.0692	0.17	1.72	33	75	0.27	
LTE-M1 12	23130	QPSK/10	3	0	Back	23	20.14	0.0667	0.28	2.06	33	75	0.31	7
LTE-M1 12	23130	QPSK/10	1	2	Right	23	20.64	0.0165	0.14	1.72	33	75	0.06	
LTE-M1 12	23130	QPSK/10	3	0	Right	23	20.14	0.0149	0.16	1.93	33	75	0.07	
LTE-M1 12	23130	QPSK/10	1	2	Bottom	23	20.64	0.0141	0.26	1.83	33	75	0.06	
LTE-M1 12	23130	QPSK/10	3	0	Bottom	23	20.14	0.0134	0.15	1.93	33	75	0.06	
LTE-M1 12	23060	QPSK/10	1	2	Back	23	19.57	0.0624	0.09	2.20	33	75	0.31	
LTE-M1 12	23095	QPSK/10	1	2	Back	23	20.19	0.0639	0.15	1.91	33	75	0.28	
LTE-M1 12	23060	QPSK/10	3	3	Back	23	19.44	0.0591	0.19	2.27	33	75	0.30	
LTE-M1 12	23095	QPSK/10	3	0	Back	23	19.85	0.0626	0.05	2.07	33	75	0.29	

*Larger than 5% drifts included to scaling factor

7.2 SAR Results for Next to Mouth Exposure Condition, front, with 10 mm separation

Band	Channel	Modulation/ BW [MHz]	RB Size	RB Offset	Test Position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR1g [W/kg]	Power Drift [dB]	Scaling Factor	Test Duty Cycle [%]	Max Duty Cycle [%]	Reported SAR 1g [W/kg]	Plot #
LTE-M1 2	19100	QPSK/20	1	2	Front	23	23.44	0.39	-0.23*	1.05	33	75	0.93	8
LTE-M1 2	19100	QPSK/20	3	0	Front	23	22.9	0.373	0.13	1.02	33	75	0.87	
LTE-M1 2	18700	QPSK/20	1	2	Front	23	22.87	0.387	0.07	1.03	33	75	0.91	
LTE-M1 2	18900	QPSK/20	1	2	Front	23	23.05	0.402	0.07	1.00	33	75	0.91	
LTE-M1 2	18700	QPSK/20	3	3	Front	23	22.74	0.378	0.1	1.06	33	75	0.91	
LTE-M1 2	18900	QPSK/20	3	0	Front	23	22.67	0.358	0.02	1.08	33	75	0.88	
LTE-M1 2	18700	QPSK/20	6	0	Front	23	22.8	0.376	0.08	1.05	33	75	0.89	
LTE-M1 2	18900	QPSK/20	1	2	Front/Repeat	23	23.05	0.375	0.06	1.00	33	75	0.85	

*Larger than 5% drifts included to scaling factor

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Band	Channel	Modulation/ BW [MHz]	RB Size	RB Offset	Test Position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR1g [W/kg]	Power Drift [dB]	Scaling Factor	Test Duty Cycle [%]	Max Duty Cycle [%]	Reported SAR 1g [W/kg]	Plot #
LTE-M1 4	20300	QPSK/20	1	2	Front	23	23.24	0.248	0.03	1.00	33	75	0.56	
LTE-M1 4	20300	QPSK/20	3	0	Front	23	22.91	0.239	0.2	1.02	33	75	0.55	
LTE-M1 4	20050	QPSK/20	1	2	Front	23	22.77	0.372	-0.15	1.05	33	75	0.89	
LTE-M1 4	20175	QPSK/20	1	2	Front	23	23.04	0.353	0.29*	1.06	33	75	0.85	
LTE-M1 4	20050	QPSK/20	3	0	Front	23	22.59	0.371	0.33*	1.19	33	75	1.00	9
LTE-M1 4	20175	QPSK/20	3	0	Front	23	22.56	0.316	0.33*	1.19	33	75	0.86	
LTE-M1 4	20175	QPSK/20	6	0	Front	23	22.72	0.327	0.22*	1.12	33	75	0.83	
LTE-M1 4	20050	QPSK/20	1	2	Front/Repeat	23	22.77	0.342	0.2	1.05	33	75	0.82	

*Larger than 5% drifts included to scaling factor

Band	Channel	Modulation/ BW [MHz]	RB Size	RB Offset	Test Position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR1g [W/kg]	Power Drift [dB]	Scaling Factor	Test Duty Cycle [%]	Max Duty Cycle [%]	Reported SAR 1g [W/kg]	Plot #
LTE-M1 12	23130	QPSK/10	1	2	Front	23	20.64	0.0131	0.17	1.72	33	75	0.05	
LTE-M1 12	23130	QPSK/10	3	0	Front	23	20.14	0.0134	-0.34*	2.09	33	75	0.06	10
LTE-M1 12	23060	QPSK/10	1	2	Front	23	19.57	0.0115	0.38*	2.40	33	75	0.06	
LTE-M1 12	23095	QPSK/10	1	2	Front	23	20.19	0.0124	0.48*	2.13	33	75	0.06	
LTE-M1 12	23060	QPSK/10	3	3	Front	23	19.44	0.0119	-0.11	2.27	33	75	0.06	
LTE-M1 12	23095	QPSK/10	3	0	Front	23	19.85	0.0129	0	2.07	33	75	0.06	

*Larger than 5% drifts included to scaling factor

7.3 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.

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APPENDIX A: PHOTOS OF THE DUT

Size of the DUT is 52x46x15 mm.

Front side of the device

Back side of the device

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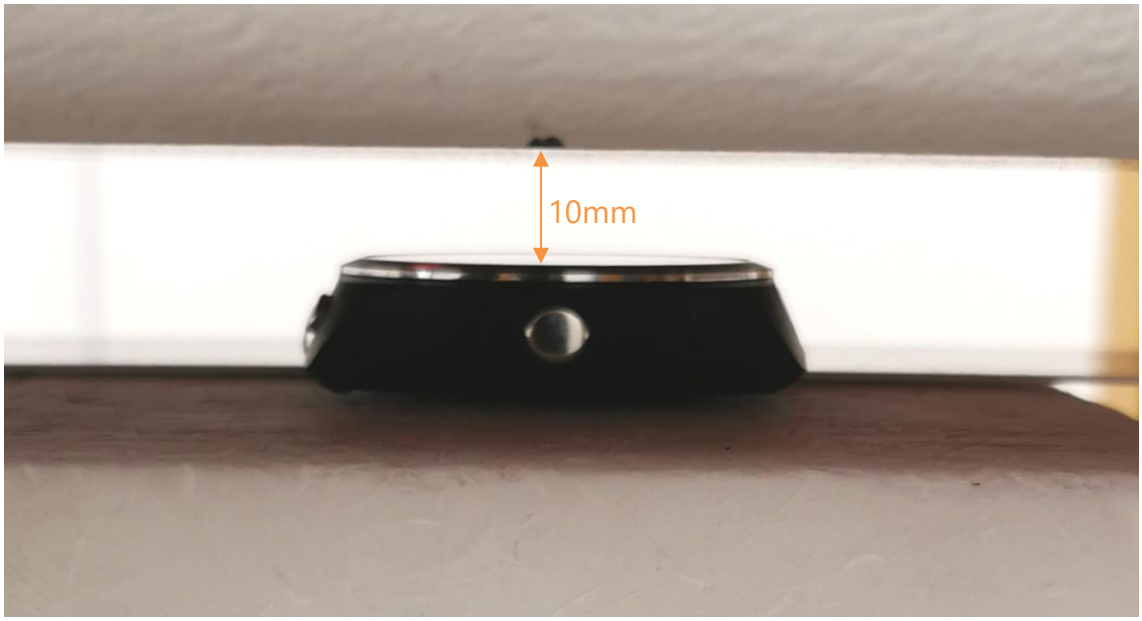
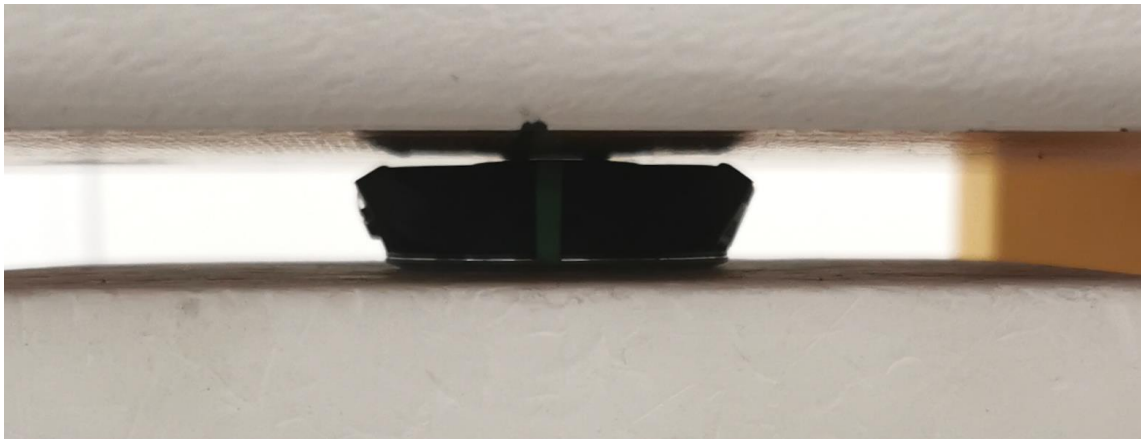


Front side of the device against the phantom, 10mm separation distance


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

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

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

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APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 10/05/2021 14.04.19

Test Laboratory: Verkotan Oy

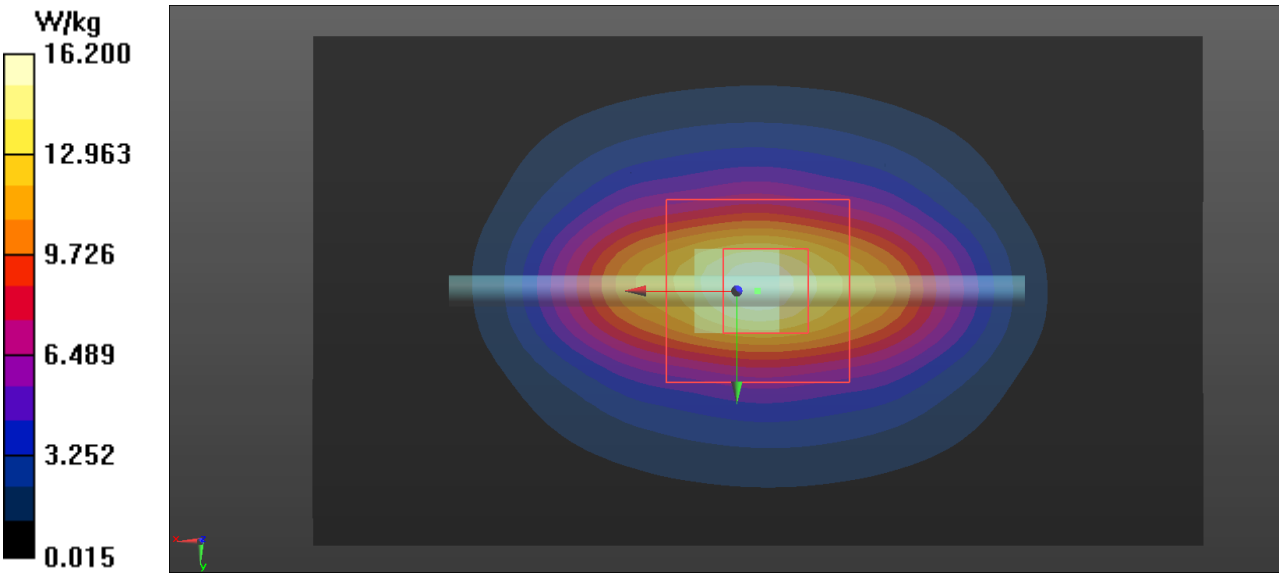
DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:511

Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1900 MHz; σ = 1.467 S/m; ε_r = 37.276; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.33, 8.33, 8.33) @ 1900 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 86.90 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.66 W/kg; SAR(10 g) = 4.96 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 10.5 mm
Ratio of SAR at M2 to SAR at M1 = 52.9%
Maximum value of SAR (measured) = 15.2 W/kg
Configuration/system check/Area Scan (71x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 16.2 W/kg



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Plot 2

Date/Time: 14/05/2021 14.23.38

Test Laboratory: Verkotan Oy

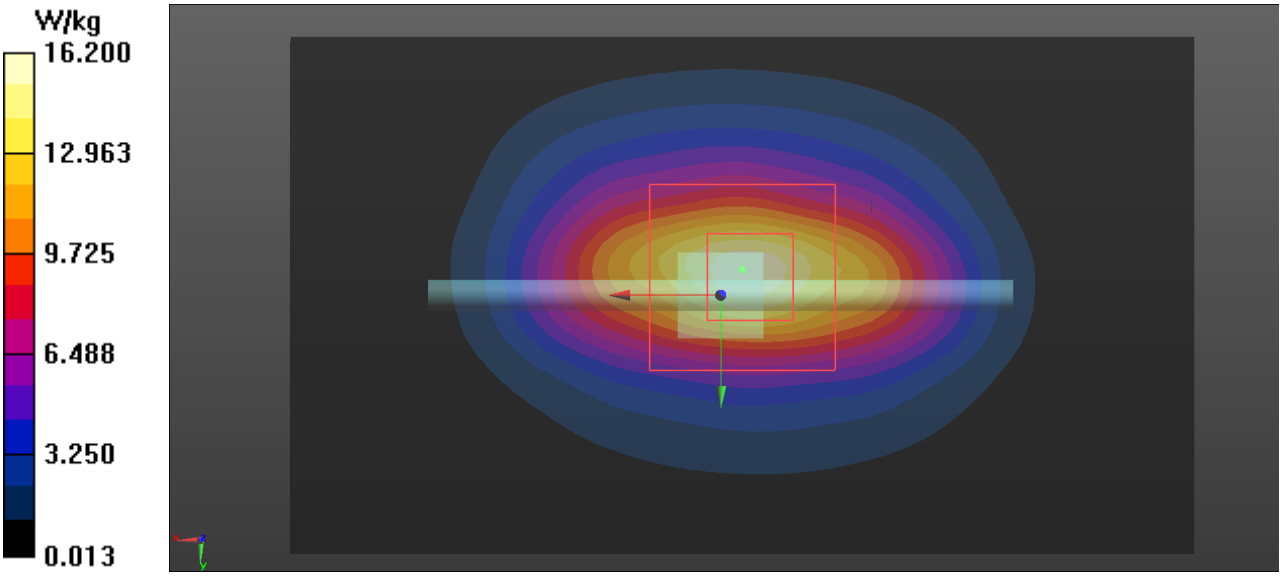
DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:511

Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1900 MHz; σ = 1.458 S/m; ε_r = 37.311; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.33, 8.33, 8.33) @ 1900 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 84.86 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 18.0 W/kg
SAR(1 g) = 9.56 W/kg; SAR(10 g) = 4.91 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 10.5 mm
Ratio of SAR at M2 to SAR at M1 = 52.6%
Maximum value of SAR (measured) = 15.0 W/kg
Configuration/system check/Area Scan (71x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 16.2 W/kg



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Plot 3

Date/Time: 17/05/2021 11.44.27

Test Laboratory: Verkotan Oy

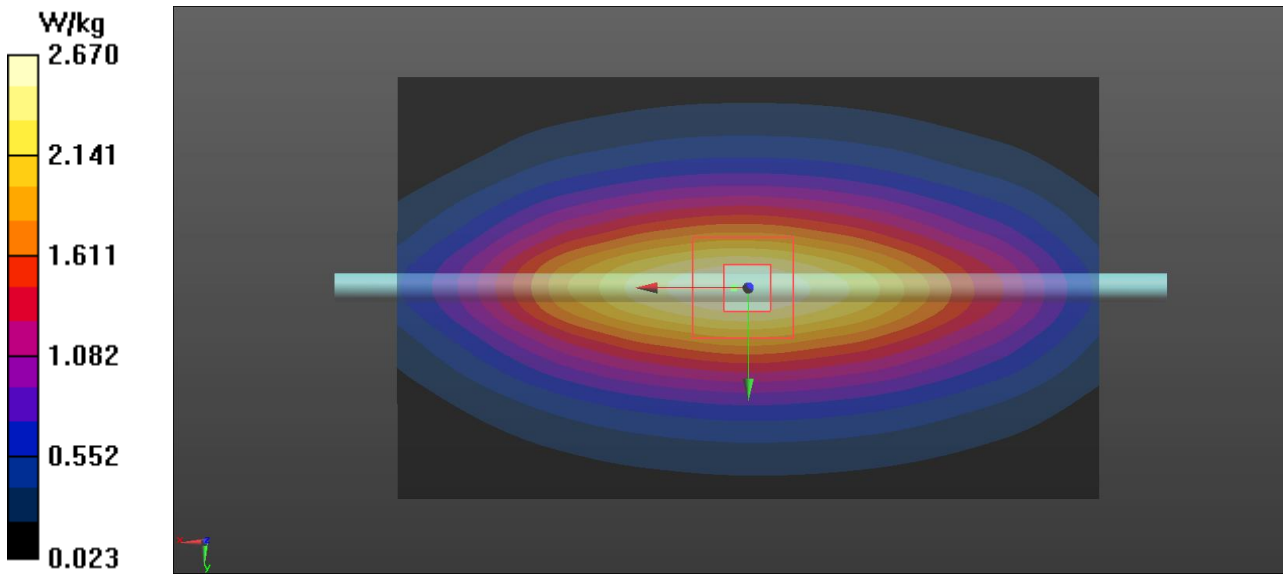
DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN:454

Communication System: UID 0, CW (0); Communication System Band: D750 (750.0 MHz); Frequency: 750 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 750 MHz; σ = 0.92 S/m; ε_r = 39.427; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(10.51, 10.51, 10.51) @ 750 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 50.93 V/m; Power Drift = -0.49 dB
Peak SAR (extrapolated) = 2.98 W/kg
SAR(1 g) = 1.98 W/kg; SAR(10 g) = 1.29 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 66%
Maximum value of SAR (measured) = 2.64 W/kg
Configuration/system check/Area Scan (101x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.67 W/kg



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Plot 4

Date/Time: 17/05/2021 8.11.34

Test Laboratory: Verkotan Oy

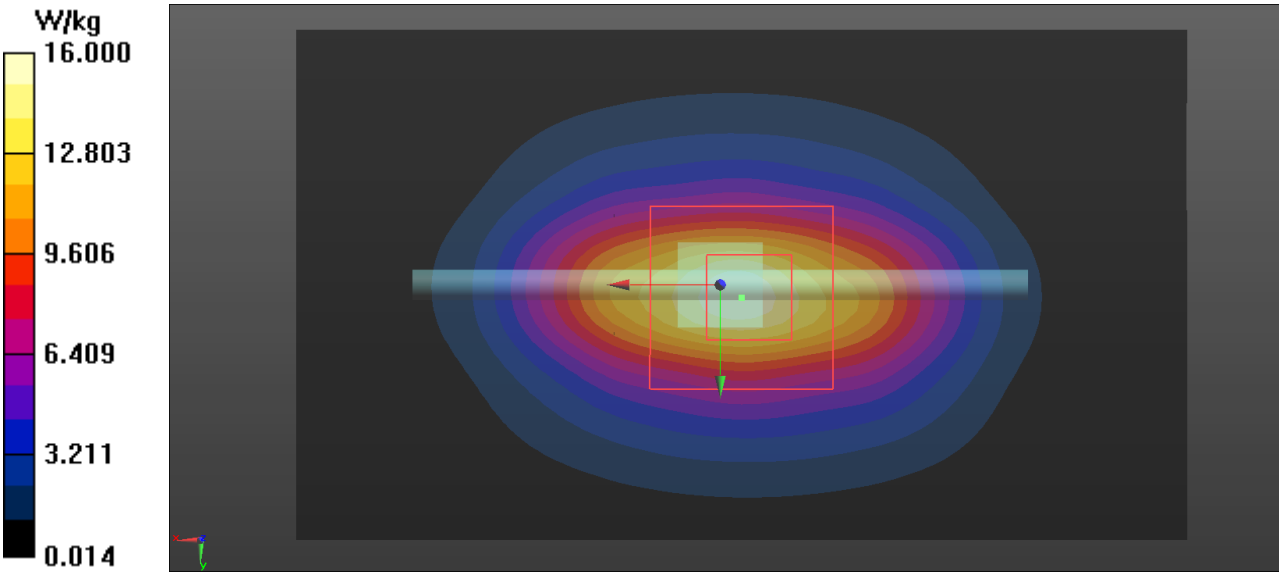
DUT: Dipole 1800 MHz D1800V2; Type: D1800V2; Serial: D1800V2 - SN:2d075

Communication System: UID 0, CW (0); Communication System Band: D1800 (1800.0 MHz); Frequency: 1800 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1800 MHz; σ = 1.392 S/m; ε_r = 37.356; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.52, 8.52, 8.52) @ 1800 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/system check/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 88.70 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 9.81 W/kg; SAR(10 g) = 5.13 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 10.5 mm
Ratio of SAR at M2 to SAR at M1 = 54.4%
Maximum value of SAR (measured) = 15.2 W/kg
Configuration/system check/Area Scan (71x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 16.0 W/kg



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APPENDIX C: MEASUREMENT SCANS

Plot 5

Date/Time: 19/05/2021 11.37.28

Test Laboratory: Verkotan Oy

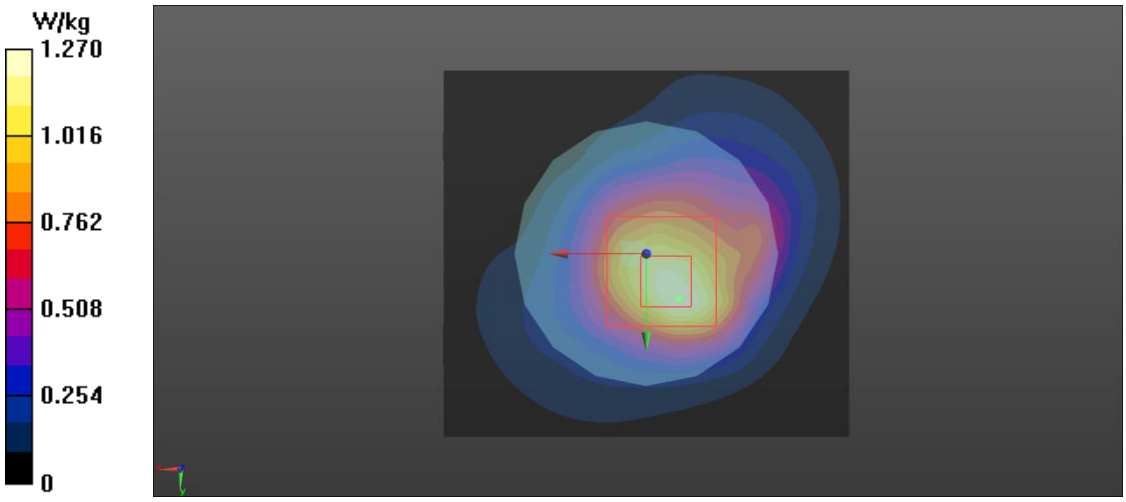
DUT: Navigil Wristwatch 580

Communication System: UID 0, LTE M1 (0); Communication System Band: Band 2; Frequency: 1860 MHz;Communication System PAR: 5.22 dB;
Medium parameters used: f = 1860 MHz; σ = 1.427 S/m; ε_r = 37.255; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.33, 8.33, 8.33) @ 1860 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/LTEM1 Band 2 LOW Back 0mm BW 20, RB Size 1 Offset 2/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 25.11 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 1.42 W/kg
SAR(1 g) = 0.856 W/kg; SAR(10 g) = 0.475 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 10.8 mm
Ratio of SAR at M2 to SAR at M1 = 59.2%
Maximum value of SAR (measured) = 1.20 W/kg
Configuration/LTEM1 Band 2 LOW Back 0mm BW 20, RB Size 1 Offset 2/Area Scan (101x91x1): Interpolated grid: dx=0.8000 mm, dy=0.8000 mm
Maximum value of SAR (interpolated) = 1.27 W/kg



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Plot 6

Date/Time: 18/05/2021 10.30.06

Test Laboratory: Verkotan Oy

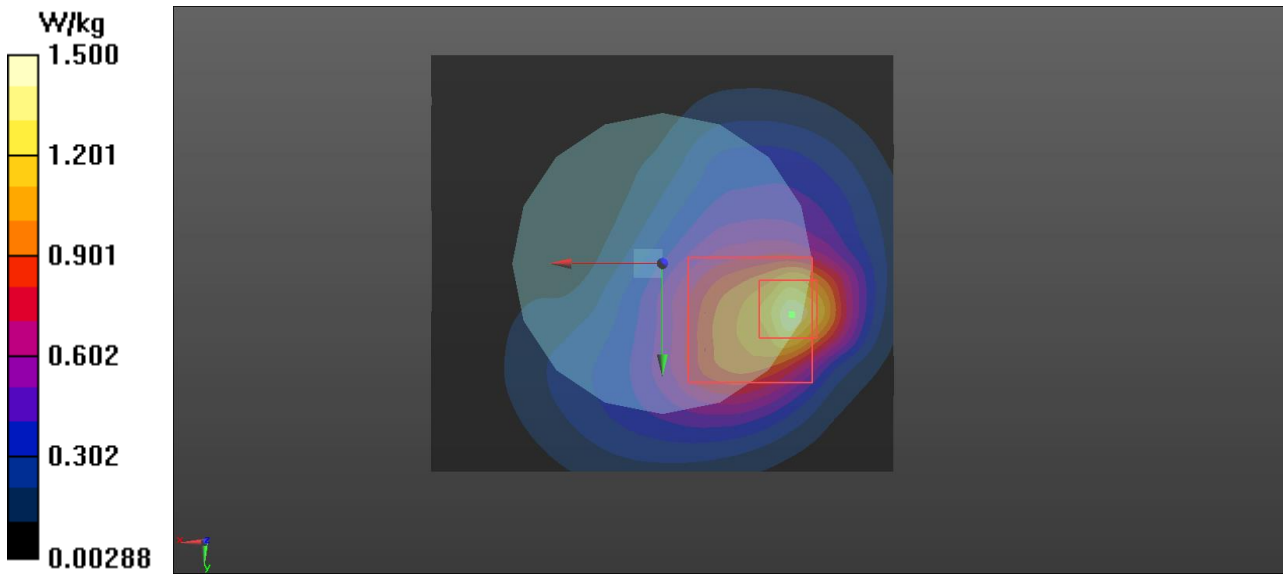
DUT: Navigil Wristwatch 580

Communication System: UID 0, LTE M1 (0); Communication System Band: Band 4; Frequency: 1745 MHz;Communication System PAR: 5.22 dB;
Medium parameters used (interpolated): f = 1745 MHz; σ = 1.361 S/m; ε_r = 37.416; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.52, 8.52, 8.52) @ 1745 MHz; Calibrated: 22/03/2021
- 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: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration 2/LTEM1 Band 4 HIGH Back 0mm BW 20, RB Size 1 Offset 2/Area Scan (101x91x1): Interpolated grid: dx=0.8000 mm, dy=0.8000 mm
Maximum value of SAR (interpolated) = 1.37 W/kg
Configuration 2/LTEM1 Band 4 HIGH Back 0mm BW 20, RB Size 1 Offset 2/Zoom Scan (8x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.75 V/m; Power Drift = 0.22 dB
Peak SAR (extrapolated) = 2.18 W/kg
SAR(1 g) = 0.787 W/kg; SAR(10 g) = 0.415 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 6.1 mm
Ratio of SAR at M2 to SAR at M1 = 30.9%
Maximum value of SAR (measured) = 1.50 W/kg



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Plot 7

Date/Time: 18/05/2021 10.15.48

Test Laboratory: Verkotan Oy

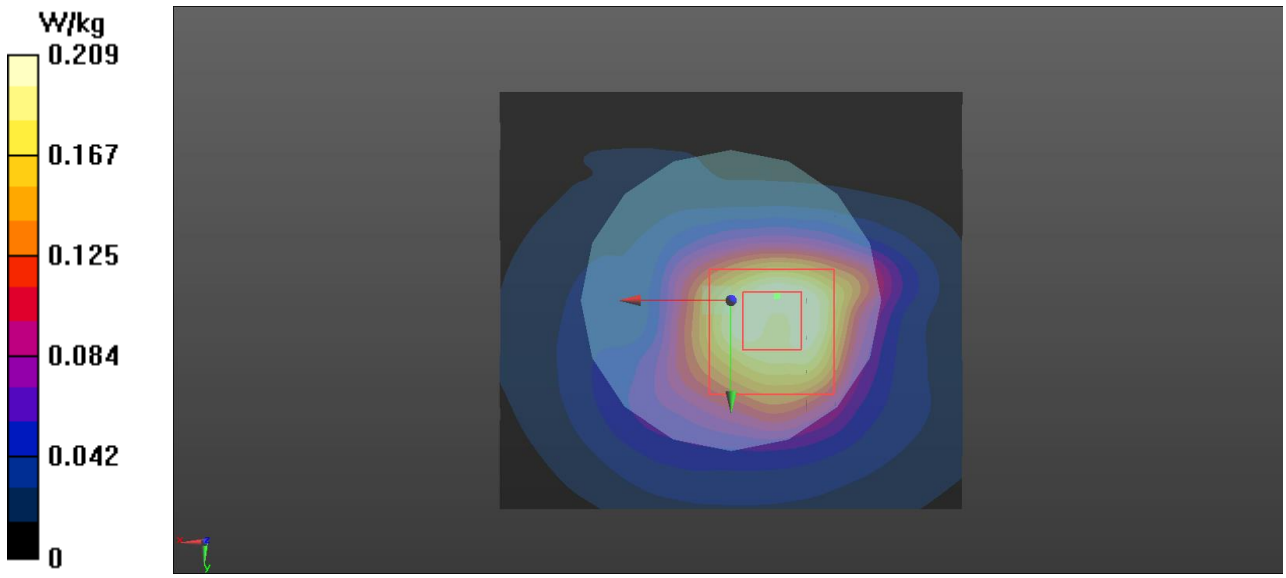
DUT: Navigil Wristwatch 580

Communication System: UID 0, LTE M1 (0); Communication System Band: Band 12; Frequency: 711 MHz;Communication System PAR: 5.22 dB;
Medium parameters used: f = 711 MHz; σ = 0.907 S/m; ε_r = 39.545; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(10.51, 10.51, 10.51) @ 711 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration 2/LTEM1 Band 12 HIGH Back 0mm BW 10, RB Size 3 Offset 0/Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.30 V/m; Power Drift = 0.28 dB
Peak SAR (extrapolated) = 0.249 W/kg
SAR(1 g) = 0.125 W/kg; SAR(10 g) = 0.067 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 49.4%
Maximum value of SAR (measured) = 0.194 W/kg
Configuration 2/LTEM1 Band 12 HIGH Back 0mm BW 10, RB Size 3 Offset 0/Area Scan (101x91x1): Interpolated grid: dx=0.8000 mm, dy=0.8000 mm
Maximum value of SAR (interpolated) = 0.209 W/kg



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Plot 8

Date/Time: 11/05/2021 15.03.28

Test Laboratory: Verkotan Oy

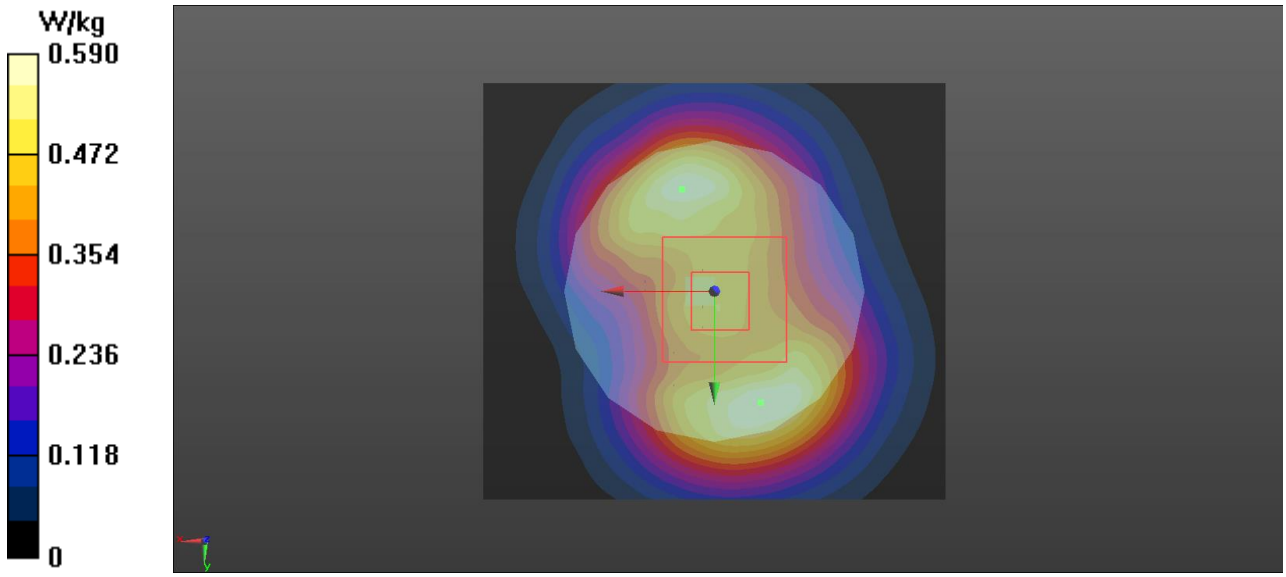
DUT: Navigil Wristwatch 580

Communication System: UID 0, LTE M1 (0); Communication System Band: Band 2; Frequency: 1900 MHz;Communication System PAR: 5.22 dB;
Medium parameters used: f = 1900 MHz; σ = 1.467 S/m; ε_r = 37.276; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.33, 8.33, 8.33) @ 1900 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/LTEM1 Band 2 High Front 10mm BW 20, RB Size 1 Offset 2/Zoom Scan (8x10x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.66 V/m; Power Drift = -0.23 dB
Peak SAR (extrapolated) = 0.719 W/kg
SAR(1 g) = 0.390 W/kg; SAR(10 g) = 0.245 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 10.3 mm
Ratio of SAR at M2 to SAR at M1 = 50.4%
Maximum value of SAR (measured) = 0.574 W/kg
Configuration/LTEM1 Band 2 High Front 10mm BW 20, RB Size 1 Offset 2/Area Scan (101x91x1): Interpolated grid: dx=0.8000 mm, dy=0.8000 mm
Maximum value of SAR (interpolated) = 0.590 W/kg



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Plot 9

Date/Time: 17/05/2021 16.19.39

Test Laboratory: Verkotan Oy

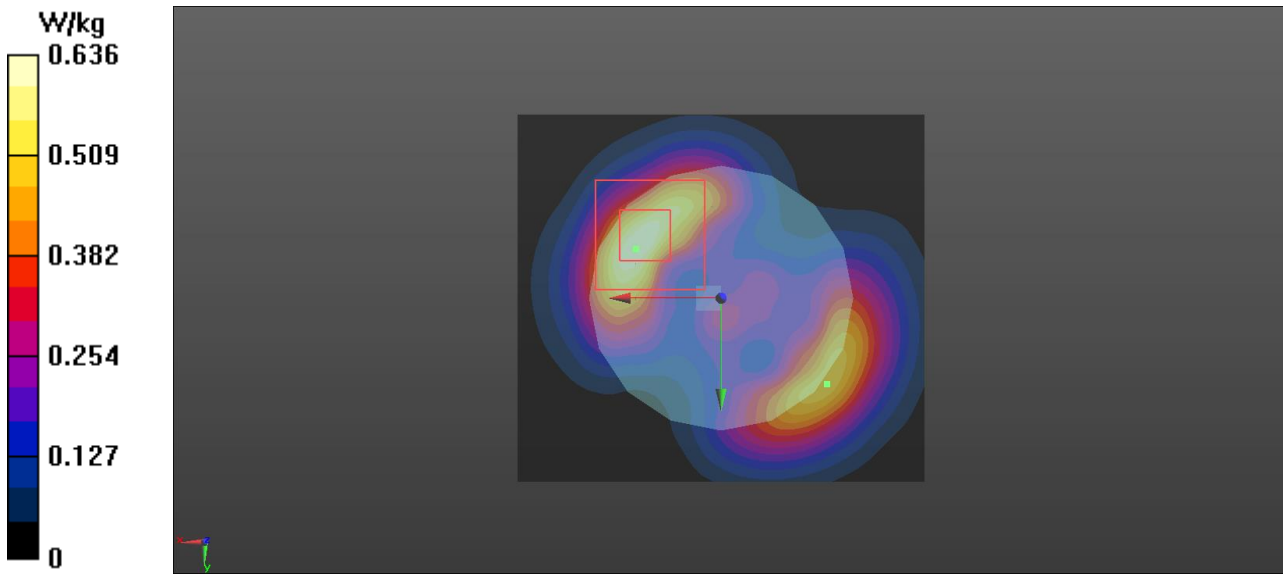
DUT: Navigil Wristwatch 580

Communication System: UID 0, LTE M1 (0); Communication System Band: Band 4; Frequency: 1720 MHz;Communication System PAR: 5.22 dB;
Medium parameters used: f = 1720 MHz; σ = 1.347 S/m; ε_r = 37.461; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.52, 8.52, 8.52) @ 1720 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/LTEM1 Band 4 LOW Front 10mm BW 20, RB Size 3 Offset 0/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.65 V/m; Power Drift = 0.33 dB
Peak SAR (extrapolated) = 0.750 W/kg
SAR(1 g) = 0.371 W/kg; SAR(10 g) = 0.173 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 7.1 mm
Ratio of SAR at M2 to SAR at M1 = 50.3%
Maximum value of SAR (measured) = 0.607 W/kg
Configuration/LTEM1 Band 4 LOW Front 10mm BW 20, RB Size 3 Offset 0/Area Scan (101x91x1): Interpolated grid: dx=0.8000 mm, dy=0.8000 mm
Maximum value of SAR (interpolated) = 0.636 W/kg



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Plot 10

Date/Time: 17/05/2021 18.48.51

Test Laboratory: Verkotan Oy

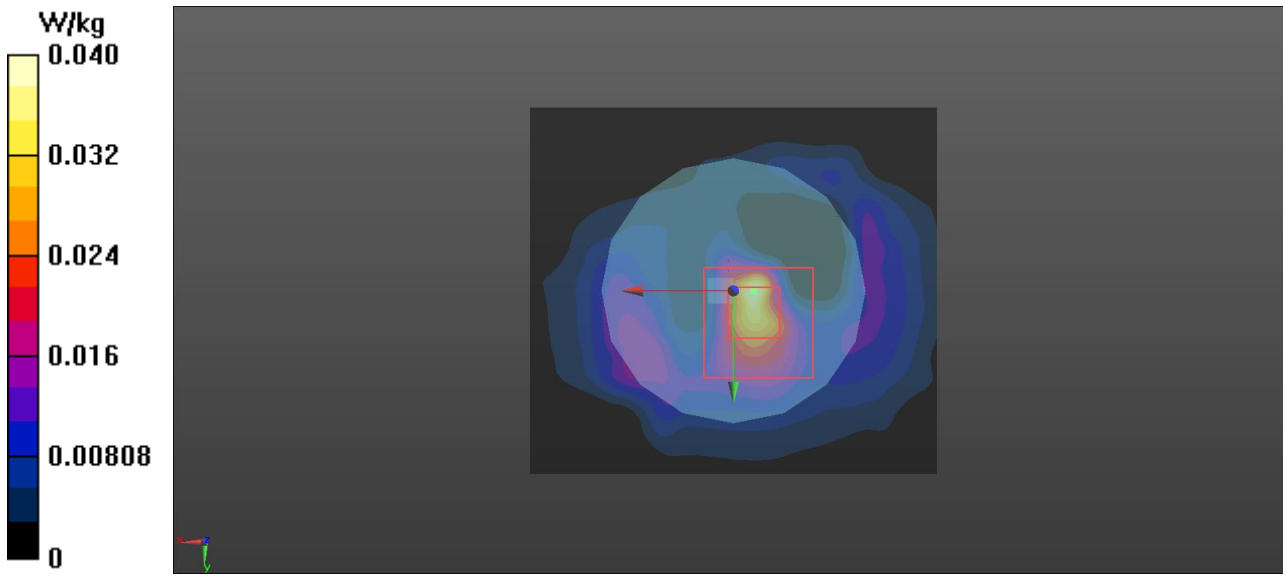
DUT: Navigil Wristwatch 580

Communication System: UID 0, LTE M1 (0); Communication System Band: Band 12; Frequency: 711 MHz;Communication System PAR: 5.22 dB;
Medium parameters used: f = 711 MHz; σ = 0.907 S/m; ε_r = 39.545; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(10.51, 10.51, 10.51) @ 711 MHz; Calibrated: 22/03/2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
- Electronics: DAE4 Sn710; Calibrated: 12/03/2021
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: xxxx
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/LTEM1 Band 12 HIGH Front 10mm BW 20, RB Size 3 Offset 0/Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.969 V/m; Power Drift = -0.34 dB
Peak SAR (extrapolated) = 0.0520 W/kg
SAR(1 g) = 0.013 W/kg; SAR(10 g) = 0.00387 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 31%
Maximum value of SAR (measured) = 0.0271 W/kg
Configuration/LTEM1 Band 12 HIGH Front 10mm BW 20, RB Size 3 Offset 0/Area Scan (101x91x1): Interpolated grid: dx=0.8000 mm, dy=0.8000 mm
Maximum value of SAR (interpolated) = 0.0404 W/kg



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APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS

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

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

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client Verkotan

Certificate No: EX3-7447_Mar21

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7447
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:	March 22, 2021

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	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: CC2552 (20x)	31-Mar-20 (No. 217-03106)	Apr-21
DAE4	SN: 660	23-Dec-20 (No. DAE4-660_Dec20)	Dec-21
Reference Probe ES3DV2	SN: 3013	30-Dec-20 (No. ES3-3013_Dec20)	Dec-21
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	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-21

	Name	Function	Signature
Calibrated by:	MIchael Weber	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 23, 2021

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

Certificate No: EX3-7447_Mar21 Page 1 of 9

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.41	0.42	0.42	± 10.1 %
DCP (mV)[B]	94.4	91.5	100.1	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	140.4	± 3.3 %	± 4.7 %
		Y	0.0	0.0	1.0		148.8		
		Z	0.0	0.0	1.0		145.0		

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] 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.

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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)
13	55.0	0.75	14.92	14.92	14.92	0.00	1.00	± 13.3 %
750	41.9	0.89	10.51	10.51	10.51	0.48	0.80	± 12.0 %
900	41.5	0.97	9.98	9.98	9.98	0.37	0.98	± 12.0 %
1750	40.1	1.37	8.52	8.52	8.52	0.36	0.86	± 12.0 %
1950	40.0	1.40	8.33	8.33	8.33	0.30	0.86	± 12.0 %
2150	39.7	1.53	8.22	8.22	8.22	0.31	0.86	± 12.0 %
2300	39.5	1.67	8.10	8.10	8.10	0.34	0.90	± 12.0 %
2450	39.2	1.80	7.85	7.85	7.85	0.31	0.90	± 12.0 %
2600	39.0	1.96	7.69	7.69	7.69	0.27	0.90	± 12.0 %
3300	38.2	2.71	7.00	7.00	7.00	0.30	1.30	± 13.1 %
5250	35.9	4.71	5.25	5.25	5.25	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.53	4.53	4.53	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.63	4.63	4.63	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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APPENDIX E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS

mvg

SAR Reference Dipole Calibration Report

Ref : ACR.353.1.18.SATU.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
MVG COMOSAR REFERENCE DIPOLE
FREQUENCY: 750 MHZ
SERIAL NO.: SN 42/17 DIP 0G750-454

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

ilac-MRA ACCREDITED

Calibration Date: 12/19/18

Summary:

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

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	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	12/19/2018	JS
Checked by :	Jérôme LUC	Product Manager	12/19/2018	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	12/19/2018	Kim Rutkowski

	Customer Name
Distribution :	Verkotan Ltd.

Issue	Date	Modifications
A	12/19/2018	Initial release

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1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 40.0 sigma : 0.93
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	750 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49	8.52 (0.85)	5.55	5.62 (0.56)
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	

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SAR Reference Dipole Calibration Report

Ref : ACR.352.4.20.MVGB.A

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

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

Calibration date: 12/17/20

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 in MVG using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

Page: 1/11

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	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Technical Manager	12/17/2020	
Checked by :	Jérôme LUC	Technical Manager	12/17/2020	
Approved by :	Yann Toutain	Laboratory Director	12/17/2020	Yann Toutain 2020.12.17 18:24:02 +01'00'

	Customer Name
Distribution :	Verkotan Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme LUC	12/17/2020	Initial release

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7.1 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 %	43.7	1.40 ±10 %	1.34
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 %	
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 %	
3300	38.2 ±10 %		2.71 ±10 %	
3500	37.9 ±10 %		2.91 ±10 %	
3700	37.7 ±10 %		3.12 ±10 %	
3900	37.5 ±10 %		3.32 ±10 %	
4200	37.1 ±10 %		3.63 ±10 %	
4600	36.7 ±10 %		4.04 ±10 %	
4900	36.3 ±10 %		4.35 ±10 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

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Software	OPENSAR V5
Phantom	SN 13/09 SAM68
Probe	SN 41/18 EPGO333
Liquid	Head Liquid Values: eps' : 43.7 sigma : 1.34
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	1800 MHz
Input power	20 dBm
Liquid Temperature	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	39.44 (3.94)	20.1	20.87 (2.09)
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		24.6	
3000	63.8		25.7	
3300	-		-	
3500	67.1		25	
3700	67.4		24.2	
3900	-		-	
4200	-		-	
4600	-		-	
4900	-		-	

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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).

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

	Customer Name
Distribution :	Verkotan Ltd.

Issue	*Name*	*Date*	*Modifications*
A	Jérôme LUC	3/24/2020	Initial release

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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 EPGO333
Liquid	Head Liquid Values: eps' : 38.5 sigma : 1.45
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	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 %	

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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	

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