SAR Compliance Test Report

Date of Report	31/10/2022	**Client's Contact person:**	Tony Vahtera
Number of pages:	54	**Responsible Test engineer:**	Jesper Varis
Testing laboratory:	**Verkotan Oy** Elektroniikkatie 17 90590 Oulu Finland	**Client:**	**AINA Wireless Finland Oy** Joensuunkatu 7G 24100 Salo Finland
Tested device	Aina Kepler, Wi-Fi		
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** 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:

For the contents:

31.10.2022

Miia Nurkkala

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Laboratory Manager

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Device under Test (DUT):

Product:	AINA Kepler, Wi-Fi
Manufacturer:	AINA Wireless Finland Oy
Serial Number:	sar 01, sar 02, sar 03
FCC ID Number:	2AH78-AKEPLERW
IC ID Number:	21419-AKEPLERW
Model:	AKEPLER-0010-01
DUT Number:	21800, 21801, 21806
Battery Type used in testing:	Rechargeable Li-Polymer Battery
State of the Sample	Production sample

Testing information:

Testing Performed:	12.8.2022 – 19.8.2022
Notes:	-
Document ID:	FCC_ISED SAR report AINA KEPLER WiFi ID5710 11102022.docx
Document History	Initial version
Temperature °C	22±2 / Controlled
Humidity RH%	20±20 / Controlled
Measurement performed by:	Jesper Varis, Kalle Orava
FCC Test Firm Designation number	FI0005
ISED Company Number	22218

1.2 Maximum Results

The maximum reported* SAR values for in Front-of-the-Face and for Body-worn 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 Health Canada's RF exposure guideline, Safety Code 6 and in FCC 47 CFR part 2 (2.1093) is SAR1g 1.6 W/kg.

System	Highest Reported* SAR_{1g}(W/kg) in Front-of-Face Condition, 25mm separation	Result
WLAN 2.4 GHz	**0**	**PASS**
WLAN 5 GHz	**0.02**	**PASS**
Bluetooth	**0.00001**	**PASS**
NFC	**0**	**PASS**

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System	Highest Reported* SAR_{1g}(W/kg) in Body-Worn Condition, 0mm separation distance	Result
WLAN 2.4 GHz	**0.03**	**PASS**
WLAN 5 GHz	**0.15**	**PASS**
Bluetooth	**0.002**	**PASS**
NFC	**0.05**	**PASS**

* Reported SAR Values are scaled to maximum theoretical output power.

1.2.1 Simultaneous Transmission SAR

Highest Simultaneous Transmission SAR	Highest Reported* SAR1g(W/kg) in Front-of-Face Condition, 25mm separation	Highest Reported* SAR_{1g}(W/kg) in Body-Worn Condition, 0mm separation distance	Result
WLAN + ISM + NFC + BT	**0.17**	**0.50**	**PASS**

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

1.2.2 Maximum Drift

Maximum Drift During Measurements	0.82dB*

*Drifts >5% have been considered in the scaling factor

1.2.3 Measurement Uncertainty

4MHz – 300MHz frequency range

Expanded Uncertainty (k=2) 95 %	±22.9%

300MHz – 3GHz frequency range

Expanded Uncertainty (k=2) 95 %	±22.1%

3GHz – 6GHz frequency range

Expanded Uncertainty (k=2) 95 %	±24.0%

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2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is a Push-to-Talk (PTT) device allowing instant voice messaging on the push of a button. The DUT connects directly to Wi-Fi network and Direct-Mode-Operation (DMO) allows communication even if Wi-Fi network is temporarily unavailable.

Datasheet of the P/N 2450AT18A100 states that the ISM 2.4GHz maximum antenna gain is 0.5 dBi.

Device Category	Portable
Exposure Environment	Uncontrolled

2.1 Supported Frequency Bands and Operational Modes

	Modes of Operation	Transmitter Frequency Range [MHz]
TX Frequency bands	**WLAN 2.4 GHz**	2412 – 2462
	WLAN 5 GHz	5180 – 5825
	Bluetooth	2402 – 2480
	ISM 2.4 GHz	2413 – 2470
	NFC	13.56

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2.2 Simultaneous Transmission

The DUT supports following simultaneous transmission combinations:
WLAN + ISM + NFC + BT

2.3 Test Exclusions

2.3.1 FCC

FCC SAR test exclusion threshold is calculated according to 447498D04 Interim General RF Exposure Guidance, equation B.2 and B.1:

$$Pth\ (mW) = \begin{cases} ERP_{20\ cm}\ (d\ /\ 20cm)^{x} & d \le 20cm \\ ERP_{20\ cm} & 20cm < d \le 40cm \end{cases} \quad \text{(Equation 1)}$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \quad \text{(Equation 2)}$$

and frequency f is in GHz, d is the separation distance (cm), and ERP20cm is per Equation 3 (B.1) below.

$$ERP20cm\ (mW) = \begin{cases} 2040f & 0.3 \le f < 1.5GHz \\ 3060 & 1.5GHz \le f \le 6GHz \end{cases} \quad \text{(Equation 3)}$$

Transmission mode	Frequency [GHz]	Separation distance [cm]	P_{th} [mW]
ISM 2.4GHz	2.47	0.5	2.7

2.3.1.1 Maximum defined Output Power and ERP

Maximum output power of the DUT's ISM transmitter is 20.0 dBm i.e. 100 mW. The module is transmitting 0.1ms during 10ms period thus the duty cycle for ISM transmission is 0.1ms / 10ms = 0.01 and the maximum time averaged power is 1mW.

According to Appendix A at 447498D04 Interim General RF Exposure Guidance, the equation (B.2.) defines the thresholds for available maximum time-averaged power or maximum time-averaged ERP, whichever is greater. Since the maximum output power is greater than the ERP of the DUT for ISM 2.4GHz, it is used for SAR test exclusion.

Transmission mode	Output power [dBm]	Output power [mW]	Power Gain of Antenna, G [dBi]	ERP Output power [dBm]	ERP Output power [mW]	P_{th} [mW]
ISM 2.4GHz	0	**1**	0.5	-1.65	0.68	**2.7**

The maximum output power for ISM 2.4GHz is below the test exclusion threshold.

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2.3.2 ISED

SAR test exemption output power limits based on frequency and separation distance are from RSS-102, issue 5, 2015:

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance[4,5]

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

SAR test exclusion power threshold for 2450MHz is 4mW at ≤5mm separation distance.

2.3.2.1 Maximum defined output power and EIRP

Maximum output power of the DUT's ISM transmitter is 20.0 dBm i.e. 100 mW. The module is transmitting 0.1ms during 10ms period thus the duty cycle for ISM transmission is 0.1ms / 10ms = 0.01 and the maximum time averaged power is 1mW. Since the time averaged EIRP output power is greater than the maximum output power of the DUT for ISM 2.4GHz, it is used for SAR test exclusion.

Transmission mode	Output power [dBm]	Output power [mW]	Power Gain of Antenna, G [dBi]	EIRP Output power [dBm]	EIRP Output power [mW]
ISM 2.4GHz	0	1	0.5	0.5	**1.12**

Time-averaged EIRP output power of the ISM 2.4GHz is below the test exclusion threshold.

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3. OUTPUT POWER

3.1 Maximum Output Power

From the Customer, maximum defined output power, including tune-up tolerance.

WLAN 2.4 GHz	Max Output Power [dBm]
802.11b*	18

*802.11b power > 802.11g, n power

WLAN 5 GHz	Max Output Power [dBm]
802.11n*	13.5

*802.11n power ≥ 802.11a power

Bluetooth	Max Output Power [dBm]
Bluetooth	8

NFC	Max Output Power [dBm]
NFC 13.56 MHz	27.7

*NFC theoretical maximum output power = 3.3V * 0.18A = 0.594 W = 27.7 dBm

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3.2 Tested Conducted Power

2.4 GHz WLAN:

Standard	Transmission mode	Data rate [Mbps]	Output power [dBm]		
			CH 1 2412 MHz	CH 6 2437 MHz	CH 11 2462 MHz
802.11b	DSSS	1	13.85	13.53	13.01

5 GHz WLAN:

Standard	Channel	Frequency [MHz]	Transmission mode	Data rate	Output power [dBm]
802.11n	52	5260	OFDM	MCS0/MCS1	10.84
802.11n	56	5280			10.89
802.11n	60	5300			11.23
802.11n	64	5320			11.41
802.11n	100	5500			12.66
802.11n	112	5560			12.35
802.11n	116	5580			12.2
802.11n	128	5640			11.62
802.11n	132	5660			11.05
802.11n	149	5745			10.85
802.11n	165	5825			11.18

Bluetooth	Max Output Power [dBm]
2402 MHz	3.63
2441 MHz	3.53
2480 MHz	3.55

NFC	Max Output Power [dBm]
13.56 MHz	18.2

*Due to NFC integrated circuit impedance matching in the output and NFC antenna not being 50Ω, the measured conducted power underestimates the actual output power of the module. Mismatch with the cable for conducted power testing cable is larger than with the antenna. The measured conducted power value is used in scaling of the NFC SAR results thus the reported SAR values are overestimated.

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4. TEST EQUIPMENT

Dasy52 near field scanning systems, manufactured by SPEAG were 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.

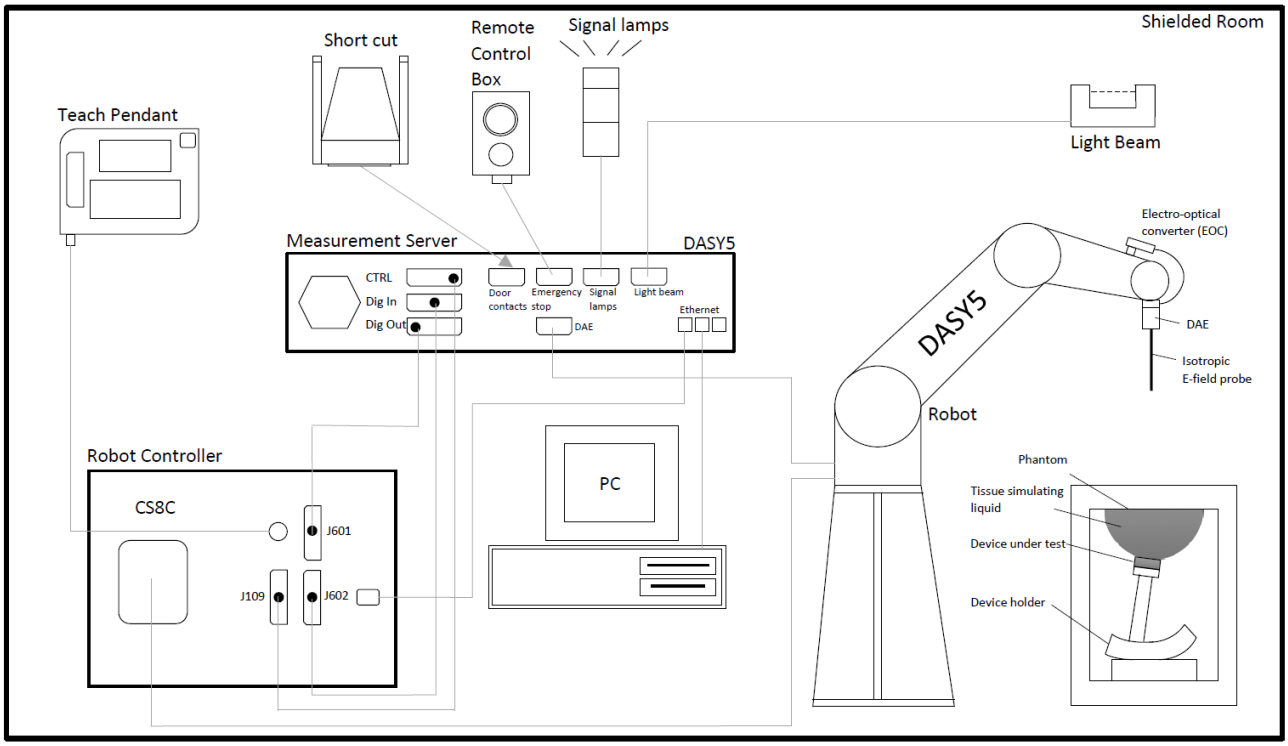

Figure 1 Schematic Laboratory Picture

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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	1332	02.2022
DAE	DAE4	710	10.2021
Probe	EX3DV4	7447	02.2022
Probe	EX3DV4	3852	10.2021
Dipole	CLA-13	1012	03.2021
Dipole	D2450V2	729	07.2022
Dipole	5GHz	1014	03.2020
DASY5 Software	52.8.8.1258	-	NA
Signal generator	Anritsu MG3710A	6261911026	02.2022
Amplifier	AR 10S1G4A	320421	NA
Amplifier	1 – 130MHz	-	NA
Power Sensor	NRP-Z11	100265	12.2021
Inline Peak Power Sensor	MA24105A	2102058	11.2021

Dipole calibration period supporting data:

		Measured on 09/2021			Calibrated		
Dipole and serial number	Frequency (MHz)	Return loss (dB)	Impedance (Ω)		Return loss (dB)	Impedance (Ω)	
D5GHzV2 - SN: 1014	5250	-26.5	53.2	-3.7	-25.81	52.5	-4.4
D5GHzV2 - SN: 1014	5600	-25.3	46.2	-3.7	-21.7	49	-8.1
D5GHzV2 - SN: 1014	5750	-22.5	45.9	5.9	-27.71	46.1	1.4

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 mW/g, Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm Tip length: 10 mm Body diameter: 12 mm Tip diameter: 2.5 mm Distance from probe tip to dipole centers: 1.0 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

4.2.1 SAM Phantom

The phantom used in SAR tests was the flat phantom section of the twin-headed "SAM Phantom" manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 and FCC published RF Exposure KPD Procedures.

4.2.2 ELI Phantom

The phantom used in SAR tests in the 13MHz frequency area 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 6 GHz. ELI is fully compatible with the 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 for frequencies below 3 GHz and ±5% for frequencies between 3 – 6 GHz. 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 600-3000 MHz tissue simulant liquid Ingredients	Head 10-400 MHz tissue simulant liquid ingredients
Deionized Water, tween, salt	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] Head tissue simulant	Conductivity σ [S/m] Head tissue simulant	Validation Done
13	CLA 13 - SN: 1012	EX3DV4 - SN: 7447	CW	DAE 4 / 1332	52.95	0.71	04.2022*
2450	D2450V2 - SN: 758	EX3DV4 - SN: 7447	CW	DAE 4 / 1332	37.82	1.79	03.2022
5250	D5GHzV2 / 1045	EX3DV4 / 3852	CW	DAE 4 / 1332	35.72	4.65	11/2021
5600	D5GHzV2 / 1045	EX3DV4 / 3852	CW / OFDM	DAE 4 / 1332	35.09	5.04	11/2021
5750	D5GHzV2 / 1045	EX3DV4 / 3852	CW	DAE 4 / 1332	34.81	5.22	11/2021

*Probe isotropy at 13 MHz was tested to be ±0.55dB. The probes consist of a sensor, the diode and two highly resistive lines. According to the probe manufacturer the performance of these lines is reduced at lower frequencies.

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4.5 System Check

Date	Tissue Type	Tissue Temp. [°C]	Frequency [MHz]	Input Power [mW]	Measured SAR1g [W/kg]	1 W Target SAR1g [W/kg]	1 W Normalized SAR1g [W/kg]	Deviation 1g [%]	Plot #
11.08.2022	WB Head	22	5250	100	7.07	77.65	70.7	-8.95	1
15.08.2022	LB Head	22	13	250	0.15	0.56	0.60	7.39	2
15.08.2022	WB Head	22	5600	100	8.54	83.31	85.4	2.51	3
15.08.2022	WB Head	22	5750	100	7.61	75.18	76.1	1.22	4
17.08.2022	WB Head	22	2450	250	12.1	52.3	48.4	-7.46	5

4.5.1 Tissue Simulant Verification

				Target		Measured		Deviation	
Date	Tissue Type	Tissue Temp [°C]	Frequency [MHz]	Dielectric Constant [ε]	Conductivity. σ [S/m]	Dielectric Constant [ε]	Conductivity σ [S/m]	ε (%)	σ (%)
11.8.2022	WB Head	22	5250	35.93	4.71	34.8	4.48	-3.1	-4.8
11.8.2022	WB Head	22	5260	35.92	4.72	34.79	4.49	-3.1	-4.8
11.8.2022	WB Head	22	5300	35.87	4.76	34.71	4.54	-3.2	-4.7
11.8.2022	WB Head	22	5320	35.85	4.78	34.69	4.56	-3.2	-4.7
15.8.2022	LB Head	22	13	55.0	0.75	54.49	0.72	-0.9	-3.4
15.8.2022	LB Head	22	13.56	55.0	0.75	54.49	0.72	-0.9	-3.4
15.8.2022	WB Head	22	5500	35.64	4.96	35.17	4.85	-1.3	-2.2
15.8.2022	WB Head	22	5560	35.57	5.02	35.06	4.92	-1.5	-2.0
15.8.2022	WB Head	22	5600	35.53	5.07	34.98	4.97	-1.5	-1.8
15.8.2022	WB Head	22	5640	35.48	5.11	34.91	5.01	-1.6	-1.8
15.8.2022	WB Head	22	5660	35.46	5.13	34.88	5.04	-1.6	-1.7
15.8.2022	WB Head	22	5745	35.36	5.21	34.73	5.14	-1.8	-1.5
15.8.2022	WB Head	22	5750	35.36	5.22	34.72	5.14	-1.8	-1.4
15.8.2022	WB Head	22	5825	35.27	5.3	34.61	5.23	-1.9	-1.3
17.8.2022	WB Head	22	2402	39.28	1.76	39.95	1.82	1.7	3.3
17.8.2022	WB Head	22	2412	39.27	1.77	39.93	1.83	1.7	3.3
17.8.2022	WB Head	22	2437	39.22	1.79	39.9	1.85	1.7	3.2
17.8.2022	WB Head	22	2441	39.22	1.79	39.9	1.85	1.7	3.1
17.8.2022	WB Head	22	2450	39.2	1.8	39.89	1.85	1.8	3.0
17.8.2022	WB Head	22	2462	39.18	1.81	39.86	1.86	1.7	2.8
17.8.2022	WB Head	22	2480	39.16	1.83	39.83	1.88	1.7	2.5

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5. TEST PROCEDURE

Testing was carried out in accordance with FCC KDB Publication 447498 D01 and RSS-102. Low, mid and high frequency channels for the configuration with the highest SAR value were tested as per ISED notice 2016-DRS001. Front side of the device was tested with 25mm separation distance. Back side of the device was tested with 0mm separation distance.

A control software was used to set the DUT to transmit at maximum power.
2.4GHz WLAN was tested with 802.11b standard with data rate of 1Mbit/s, 5GHz WLAN was tested with 802.11n standard with data rate of MCS0 (13Mbps).

NFC' theoretical maximum output power has been calculated based on the module's current limit threshold and supply voltage. Supply voltage has been set to 3.3V and current limiter threshold's value is 180 mA.

NFC theoretical maximum output power = 3.3V * 0.18A = 0.594 W = 27.7 dBm.

Due to NFC integrated circuit impedance matching in the output and NFC antenna not being 50Ω, the measured conducted power underestimates the actual output power of the module. Mismatch with the cable for conducted power testing cable is larger than with the antenna. The measured conducted power value is used in scaling of the NFC SAR results thus the reported SAR values are overestimated.

5.1 Test Positions

Photos of the test positions are presented in appendix A

5.1.1 Front-of-Face Configuration

The device was placed in the SPEAG holder front side facing the phantom and lifted towards the phantom until the distance between the phantom and the device was 25mm.

5.1.2 Body-worn, 0mm separation distance

The device was placed in the SPEAG holder and lifted towards the phantom until the distance between the phantom and the device was 0mm.

5.2 Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan with was performed around the highest E-field value to determine the averaged SAR value. Power drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

5.3 SAR Averaging Methods

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

The interpolation, extrapolation and maximum search routines within Dasy52 are all based on the modified Quadratic Shepard's method (Robert J. Renka," Multivariate Interpolation of

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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: 4MHz - 300MHz 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	±13.3%	N	√2	1	1	±6.65%	±6.65%
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	±0.8%	R	√3	1	1	±0.5%	±0.5%
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}	±5.4%	R	√3	0.78	0.71	±2.4%	±2.2%
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						±11.4%	±11.3%
U	**Expanded Uncertainty**						±22.9%	±22.6%

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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%
CFdrift	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%
Δsys	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%
Dxyz	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%
RFdrift	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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DASY5 Uncertainty Budget

According to IEC/IEEE 62209-1528

(Frequency band: 3GHz - 6GHz 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	±14.0%	N	√2	1	1	±7.0%	±7.0%
CF*drift*	Probe Calibration Drift	±1.7%	N	√3	1	1	±1.0%	±1.0%
LIN	Probe Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%
BBS	Broadband Signal	±2.6%	R	√3	1	1	±1.5%	±1.5%
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	0.33	0.33	±1.3%	±1.3%
DAT	Data Processing	±2.3%	N	1	1	1	±2.3%	±2.3%
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}	±3.4%	R	√3	0.78	0.71	±1.5%	±1.4%
EPS	Phantom Permittivity	±14.0%	R	3	0.25	0.25	±2.0%	±2.0%
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						±12.0%	±11.9%
U	**Expanded Uncertainty**						±24.0%	±23.8%

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7. TEST RESULTS

7.1 SAR Results for Front-of-Face Exposure, 25 mm separation distance and Body-worn Condition, 0 mm separation distance

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%.

2.4GHz WLAN:

Mode	Channel	Freq [MHz]	Data Rate	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR1g [W/kg]	Power Drift [dB]	Scaling Factor	Duty Cycle	Normal mode Duty Cycle [%]	Reported SAR1g [W/kg]	Plot #
802.11b	2412	1	1 Mbps	Front 25mm	18	13.85	0**	NA***	2.60	1:1	50	0	
802.11b	2412	1	1 Mbps	Back 0mm	18	13.85	0.01	0.82*	3.14	1:1	50	0.02	
802.11b	2437	6	1 Mbps	Back 0mm	18	13.53	0.02	-0.31*	3.01	1:1	50	0.02	
802.11b	2462	11	1 Mbps	Back 0mm	18	13.01	0.02	0.24*	3.33	1:1	50	0.03	6

*Larger than 5% drifts included to scaling factor
**SAR is below the detection limit of the test system
*** Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable

5GHz WLAN:

Mode	Channel	Freq [MHz]	Data Rate	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR1g [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Normal mode Duty Cycle [%]	Reported SAR1g [W/kg]	Plot #
802.11n	5320	64	MCS1	Front 25mm	13.5	11.41	0.027	-0.21	1.62	1:1	50	0.02	
802.11n	5320	64	MCS1	Back 0mm	13.5	11.41	0.136	-0.04	1.62	1:1	50	0.11	
802.11n	5260	52	MCS1	Back 0mm	13.5	10.84	0.158	0.09	1.85	1:1	50	0.15	
802.11n	5300	60	MCS1	Back 0mm	13.5	10.89	0.166	0.15	1.82	1:1	50	0.15	7

Mode	Channel	Freq [MHz]	Data Rate	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR1g [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Normal mode Duty Cycle [%]	Reported SAR1g [W/kg]	Plot #
802.11n	5500	100	MCS0	Front 25mm	13.5	12.66	0.029	-0.21	1.21	1:1	50	0.02	
802.11n	5500	100	MCS0	Back 0mm	13.5	12.66	0.133	0.15	1.21	1:1	50	0.08	8
802.11n	5560	112	MCS0	Back 0mm	13.5	12.35	0.110	0.02	1.30	1:1	50	0.07	
802.11n	5640	128	MCS0	Back 0mm	13.5	11.62	0.075	0.18	1.54	1:1	50	0.06	

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Mode	Channel	Freq [MHz]	Data Rate	Test position	Maximum Power [dBm]	Conducted Power [dBm]	Measured SAR1g [W/kg]	Power Drift [dB]*	Scaling Factor	Duty Cycle	Normal Duty Cycle [%]	Reported SAR1g [W/kg]	Plot #
802.11n	5825	165	MCS1	Front 25mm	13.5	11.18	0.001	0.42	1.88	1:1	50	0.001	
802.11n	5825	165	MCS1	Back 0mm	13.5	11.18	0.03	0.15	1.71	1:1	50	0.03	
802.11n	5660	132	MCS1	Back 0mm	13.5	11.05	0.07	-0.3	1.88	1:1	50	0.06	9
802.11n	5745	149	MCS1	Back 0mm	13.5	10.85	0.04	-0.09	1.84	1:1	50	0.03	

*Larger than 5% drifts included to scaling factor

Band	Freq [MHz]	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Duty Cycle	Measured SAR_{1g} [mW/g]	Power Drift [dB]	Scaling Factor	Normal Duty Cycle [%]	Reported SAR_{1g} [mW/g]	Plot #
Bluetooth	2402	8	3.63	Front 25mm	1:1	0.0001	NA*	2.74	50	0.00001	
Bluetooth	2402	8	3.63	Back 0mm	1:1	0.0001	NA*	2.74	50	0.00001	
Bluetooth	2441	8	3.53	Back 0mm	1:1	0.0062	NA*	2.80	50	0.0009	
Bluetooth	2480	8	3.55	Back 0mm	1:1	0.0173	NA*	2.79	50	0.002	10

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

Band	Freq [MHz]	Maximum Power [dBm]	Conducted Power [dBm]	Test position	Duty Cycle	Measured SAR_{1g} [mW/g]	Power Drift [dB]	Scaling Factor	Normal Duty Cycle [%]	Reported SAR_{1g} [mW/g]	Plot #
NFC	13.56	27.7	18.2	Front 25mm	1:1	0**	NA***	8.91	50	0	
NFC	13.56	27.7	18.2	Back 0mm	1:1	0.009	0.5*	10.00	50	0.05	11

*Larger than 5% drifts included to scaling factor
**SAR is below the detection limit of the test system
*** Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable

The pictures of the test positions are presented in Appendix A.

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7.2 Calculated ISM 2.4GHz SAR

7.2.1 FCC

For simultaneous transmission evaluation the estimated standalone SAR values are calculated according to the following equation 4.

$SARestimated$=0.4$*Pant/Pth$ [w/kg] (Equation 4)

Estimated ISM 2.4GHz SAR = 0.4*(1/2.7) = 0.15 W/kg

7.2.2 ISED

The estimated SAR value for ISM 2.4GHz is evaluated according to the following equation stated in Notice 2016-DRS001:

(maximum power level including tune-up tolerance for transmitter A / maximum power level of exemption at the same frequency and distance) * 0.4 W/kg

According to RSS-102, issue 5, 2015, the SAR test exclusion power threshold for 2.45GHz is 4mW at ≤5mm separation distance.

Estimated ISM 2.4GHz SAR = 1.12/4*0.4 = 0.11 W/kg

7.3 Simultaneous Transmission Analysis

Since the calculated ISM 2.4GHz SAR for FCC is higher than for ISED, simultaneous transmission analysis is evaluated by using FCC calculated SAR. Simultaneous transmission analysis for WLAN SAR, maximum Bluetooth SAR, maximum ISM SAR and maximum NFC SAR is in a table below. Direct summation of SAR results was performed.

	Exposure Condition	Front-of-Face SAR_{1g} [W/kg]	Body SAR_{1g} [W/kg]
	Test Position	**Front 25mm**	**Back 0mm**
WLAN 2.4GHz		0	0.03
WLAN 5GHz		0.02	0.15
Maximum WLAN		0.02	0.30
ISM 2.4GHz		0.15	0.15
NFC		0	0.05
Bluetooth		0.00001	0.002
SAR Summation WLAN + ISM + NFC + BT		**0.17**	**0.5**

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APPENDIX A: PHOTOS OF THE DUT

Size of the DUT is: 77.7 x 111.8 x 29.7 mm

DUT front side and back side.

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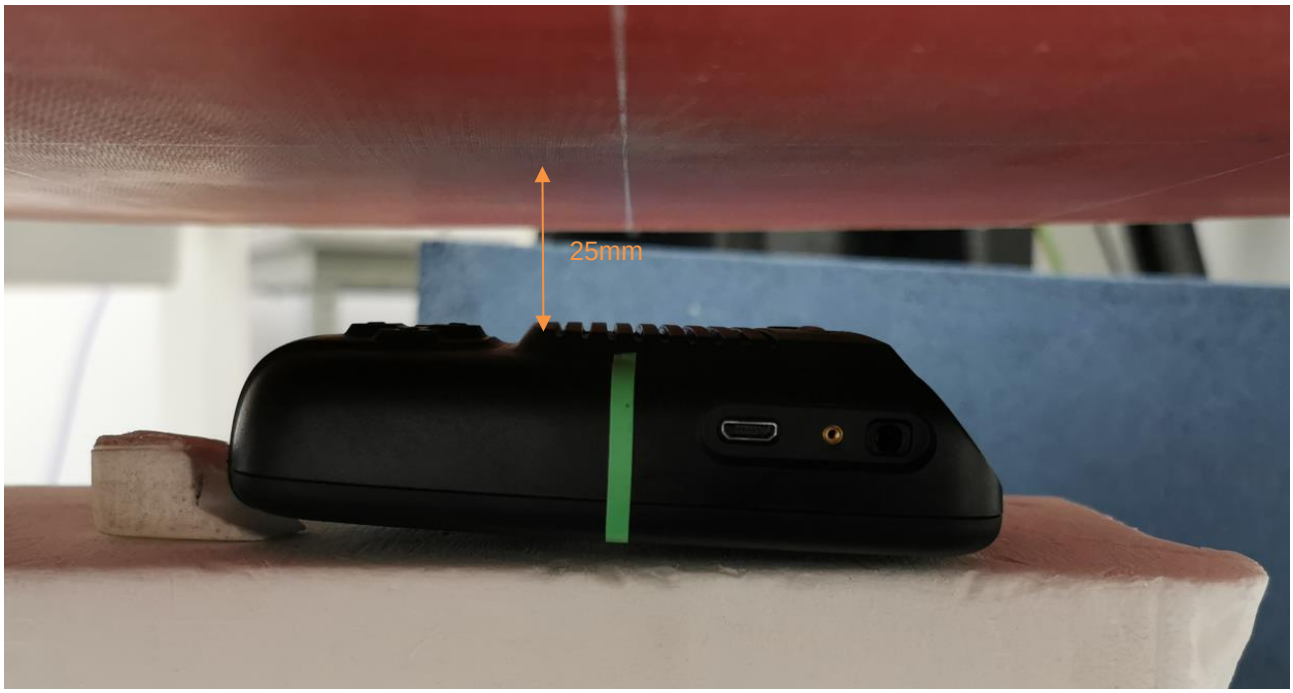

Front side of the device against the phantom, 25mm separation distance

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

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APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 11/08/2022 11:45:31

Test Laboratory: Verkotan Oy

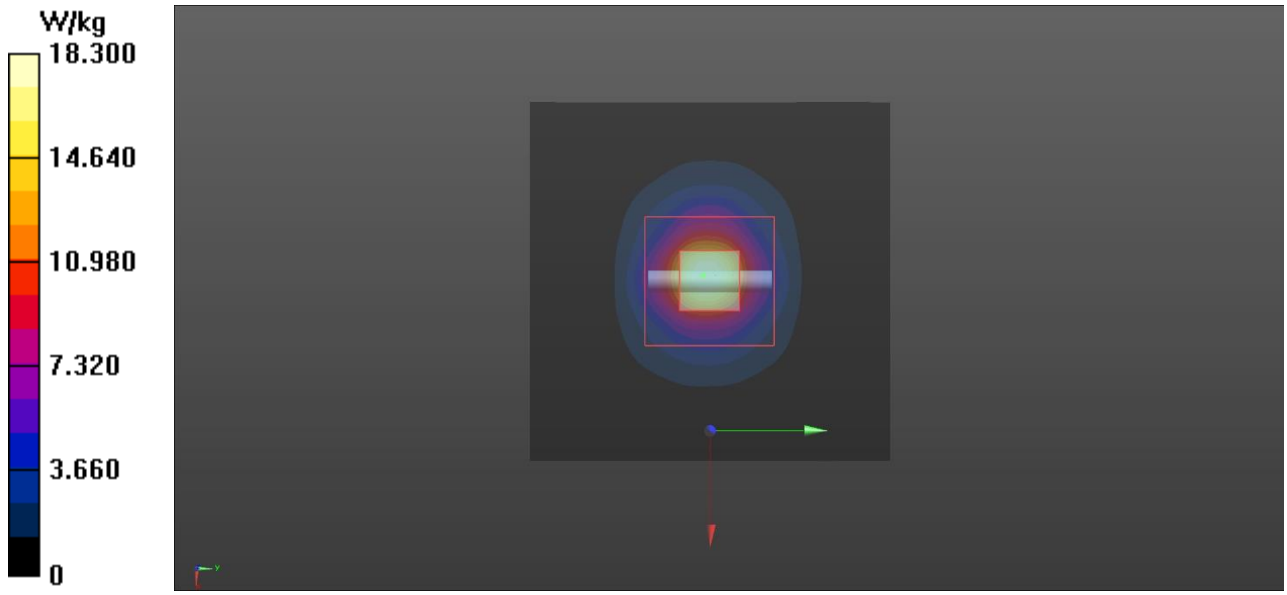
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1014

Communication System: UID 0, WLAN5GHz (0); Communication System Band: 5GHz; Frequency: 5250 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 5250 MHz; σ = 4.48 S/m; ε_r = 34.801; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(5.2, 5.2, 5.2) @ 5250 MHz; Calibrated: 28/02/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 25.0
  - Electronics: DAE4 Sn1332; Calibrated: 23/02/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/System check 5250mhz/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.3 W/kg
Configuration/System check 5250mhz/Zoom Scan (7x7x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 44.42 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 29.3 W/kg
SAR(1 g) = 7.07 W/kg; SAR(10 g) = 1.99 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 5.6 mm
Ratio of SAR at M2 to SAR at M1 = 65.5%
Maximum value of SAR (measured) = 17.9 W/kg



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Plot 2

Date/Time: 15/08/2022 14:36:55

Test Laboratory: Verkotan Oy

DUT: CLA-13 - SN1012; Type: CLA-13; Serial: SN1007

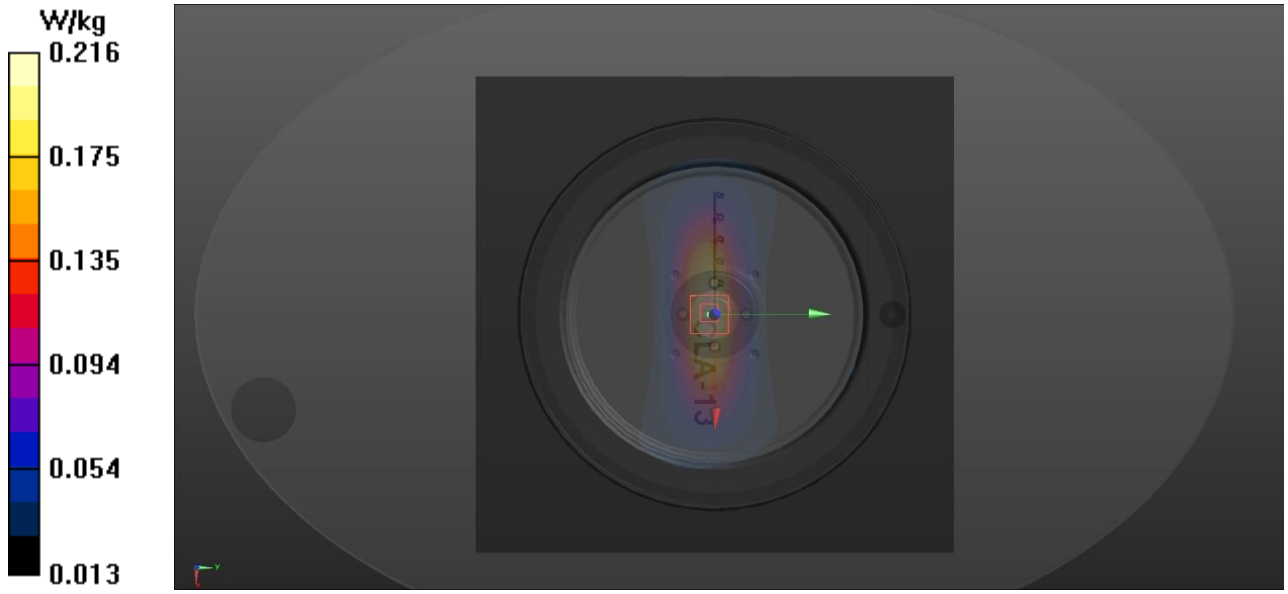
Communication System: UID 0, CW (0); Communication System Band: CW; Frequency: 13 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 13 MHz; σ = 0.724 S/m; ε_r = 55.295; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(15.43, 15.43, 15.43) @ 13 MHz; Calibrated: 28/02/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
  - Electronics: DAE4 Sn1332; Calibrated: 23/02/2022
  - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/System check_NFC 13MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 17.04 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 0.267 W/kg
SAR(1 g) = 0.149 W/kg; SAR(10 g) = 0.092 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 15.3 mm
Ratio of SAR at M2 to SAR at M1 = 55%
Maximum value of SAR (measured) = 0.216 W/kg

Configuration/System check_NFC 13MHz/Area Scan (181x181x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.216 W/kg



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Plot 3

Date/Time: 15/08/2022 12:22:20

Test Laboratory: Verkotan Oy

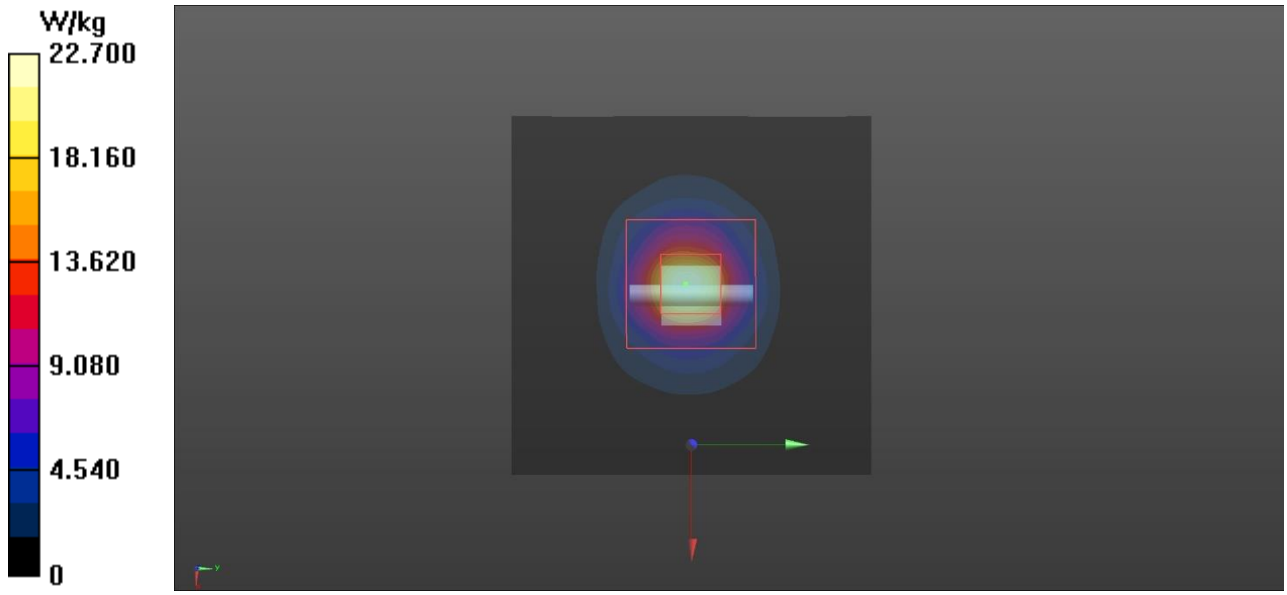
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1014

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5600 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 5600 MHz; σ = 4.972 S/m; ε_r = 34.984; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.61, 4.61, 4.61) @ 5600 MHz; Calibrated: 21/10/2021
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 25.0, -4.0
  - Electronics: DAE4 Sn705; Calibrated: 12/04/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/System check 5600mhz/Zoom Scan (7x7x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 42.75 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 38.6 W/kg
SAR(1 g) = 8.54 W/kg; SAR(10 g) = 2.38 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 6.8 mm
Ratio of SAR at M2 to SAR at M1 = 61.9%
Maximum value of SAR (measured) = 22.7 W/kg
Configuration/System check 5600mhz/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 22.3 W/kg



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Plot 4

Date/Time: 15/08/2022 11:45:11

Test Laboratory: Verkotan Oy

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1014

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5750 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 5750 MHz; σ = 5.144 S/m; ε_r = 34.72; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

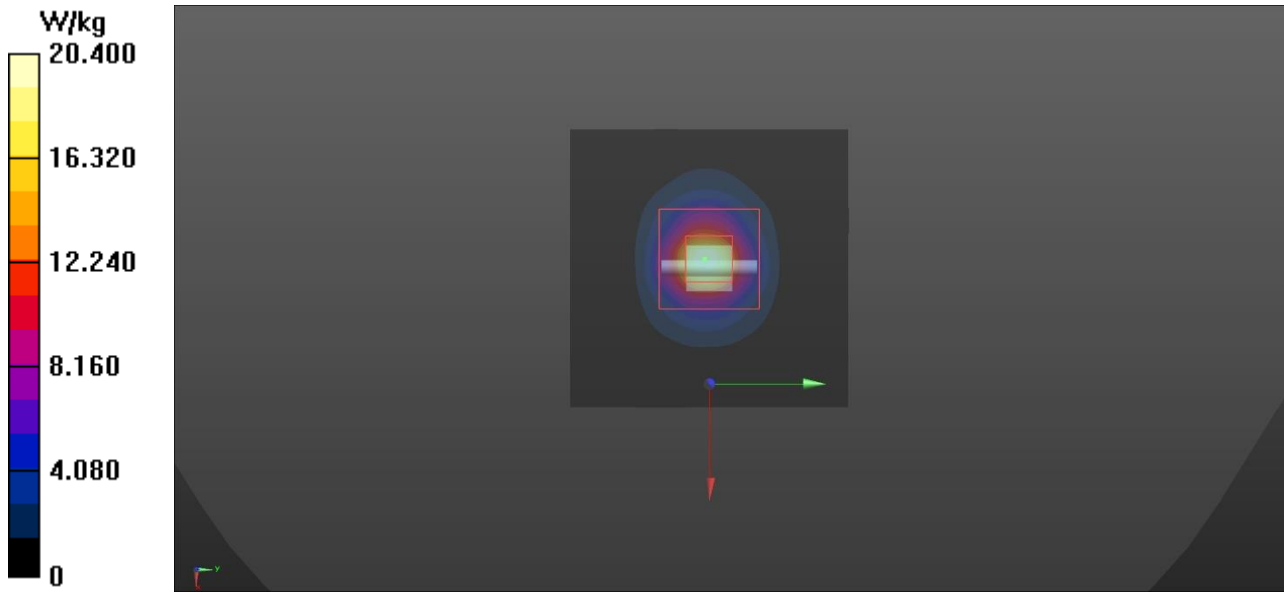
DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.69, 4.69, 4.69) @ 5750 MHz; Calibrated: 21/10/2021
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 25.0, -4.0
  - Electronics: DAE4 Sn705; Calibrated: 12/04/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/System check 5750mhz/Zoom Scan (7x7x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 39.96 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 35.5 W/kg
SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.13 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 60.8%

Maximum value of SAR (measured) = 20.4 W/kg

Configuration/System check 5750mhz/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.6 W/kg



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Date/Time: 17/08/2022 12:23:44

Test Laboratory: Verkotan Oy

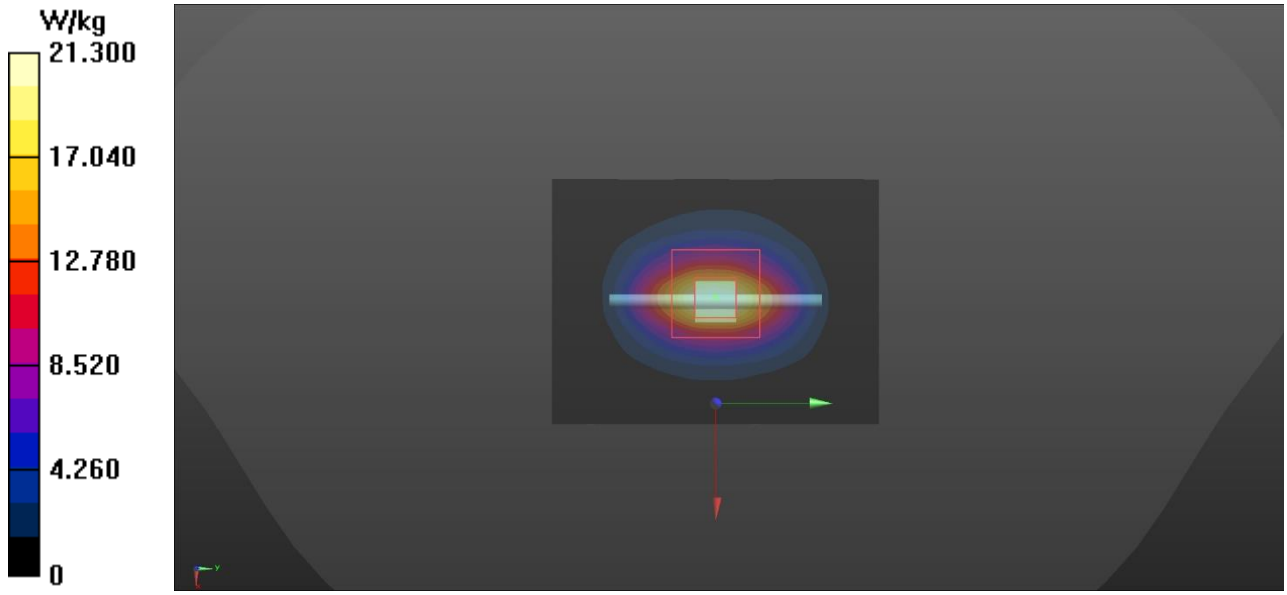
DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:729

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.854 S/m; ε_r = 39.888; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.77, 7.77, 7.77) @ 2450 MHz; Calibrated: 28/02/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 23/02/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/system check 2450MHz/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 21.3 W/kg
Configuration/system check 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.86 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 25.5 W/kg
SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.63 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 49.9%
Maximum value of SAR (measured) = 13.9 W/kg



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APPENDIX C: MEASUREMENT SCAN

Plot 6

Date/Time: 17/08/2022 15:34:13

Test Laboratory: Verkotan Oy

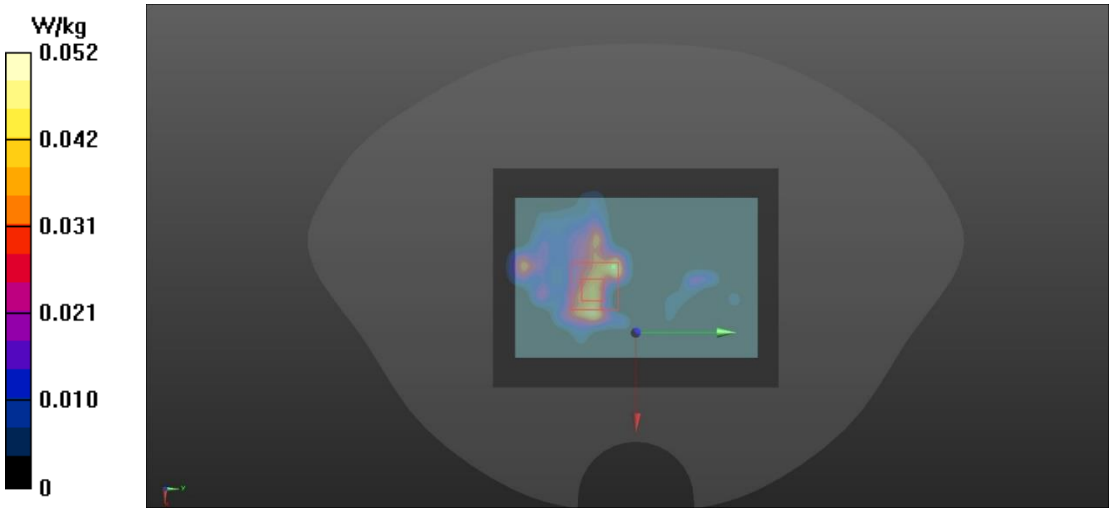
DUT: AINA Kepler

Communication System: UID 0, WLAN 2.4 (0); Communication System Band: WLAN2.4GHz; Frequency: 2462 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 2462 MHz; σ = 1.863 S/m; ε_r = 39.864; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.77, 7.77, 7.77) @ 2462 MHz; Calibrated: 28/02/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 23/02/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/WLAN 2.4GHz CH 11, Back 0mm/Area Scan (131x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.0523 W/kg
Configuration/WLAN 2.4GHz CH 11, Back 0mm/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.858 V/m; Power Drift = 0.24 dB
Peak SAR (extrapolated) = 0.0390 W/kg
SAR(1 g) = 0.018 W/kg; SAR(10 g) = 0.00565 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 = 37%
Maximum value of SAR (measured) = 0.0337 W/kg



Copyright © Verkotan

Date/Time: 12/08/2022 10:13:31

Test Laboratory: Verkotan Oy

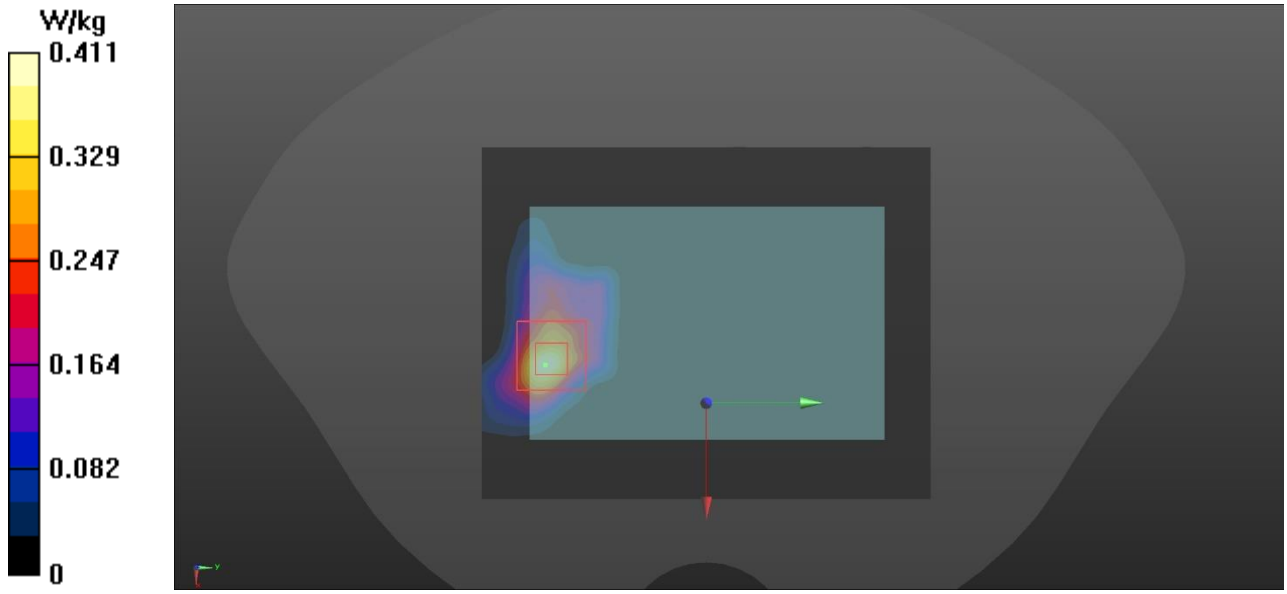
DUT: AINA Kepler

Communication System: UID 0, WLAN5GHz (0); Communication System Band: 5GHz; Frequency: 5300 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 5300 MHz; σ = 4.536 S/m; ε_r = 34.713; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(5.2, 5.2, 5.2) @ 5300 MHz; Calibrated: 28/02/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection), z = -4.0, 25.0
  - Electronics: DAE4 Sn1332; Calibrated: 23/02/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/WLAN 5GHz, 0mm, CH60 BACK/Area Scan (141x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.411 W/kg
Configuration/WLAN 5GHz, 0mm, CH60 BACK/Zoom Scan (9x9x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 6.723 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.621 W/kg
SAR(1 g) = 0.166 W/kg; SAR(10 g) = 0.053 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 8.5 mm
Ratio of SAR at M2 to SAR at M1 = 65%
Maximum value of SAR (measured) = 0.404 W/kg



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Plot 8

Date/Time: 15/08/2022 13:43:50

Test Laboratory: Verkotan Oy

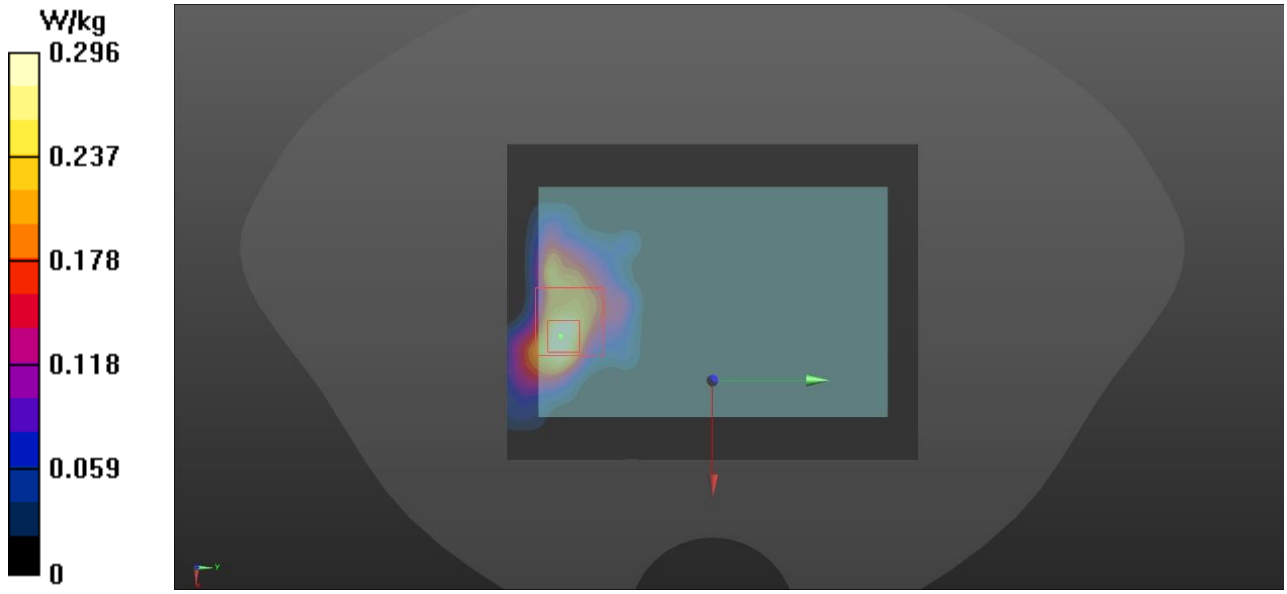
DUT: AINA Kepler

Communication System: UID 0, WLAN5GHz (0); Communication System Band: 5GHz; Frequency: 5500 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 5500 MHz; σ = 4.854 S/m; ε_r = 35.166; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.61, 4.61, 4.61) @ 5500 MHz; Calibrated: 21/10/2021
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 25.0
  - Electronics: DAE4 Sn705; Calibrated: 12/04/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/WLAN 5GHz, 25mm, CH100 BACK/Area Scan (131x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.296 W/kg
Configuration/WLAN 5GHz, 25mm, CH100 BACK/Zoom Scan (9x9x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 6.448 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.499 W/kg
SAR(1 g) = 0.133 W/kg; SAR(10 g) = 0.046 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 8.2 mm
Ratio of SAR at M2 to SAR at M1 = 61.8%
Maximum value of SAR (measured) = 0.315 W/kg



Plot 9

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Date/Time: 17/08/2022 08:46:44

Test Laboratory: Verkotan Oy

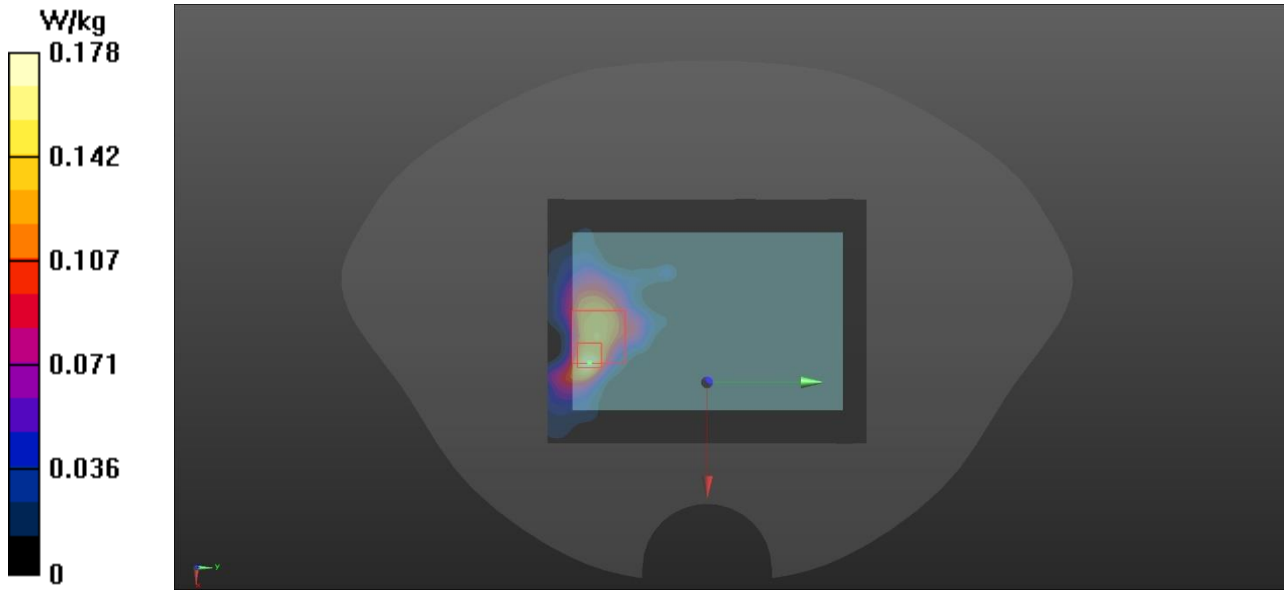
DUT: AINA Kepler

Communication System: UID 0, WLAN5GHz (0); Communication System Band: 5GHz; Frequency: 5660 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 5660 MHz; σ = 5.039 S/m; ε_r = 34.883; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.61, 4.61, 4.61) @ 5660 MHz; Calibrated: 21/10/2021
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 25.0
  - Electronics: DAE4 Sn705; Calibrated: 12/04/2022
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/WLAN 5GHz, 0mm, CH132 BACK/Zoom Scan (11x9x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 6.839 V/m; Power Drift = -0.30 dB
Peak SAR (extrapolated) = 0.286 W/kg
SAR(1 g) = 0.069 W/kg; SAR(10 g) = 0.024 W/kg (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 6.2 mm
Ratio of SAR at M2 to SAR at M1 = 60.3%
Maximum value of SAR (measured) = 0.178 W/kg
Configuration/WLAN 5GHz, 0mm, CH132 BACK/Area Scan (131x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.222 W/kg



Plot 10

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Date/Time: 19/08/2022 07:17:16

Test Laboratory: Verkotan Oy

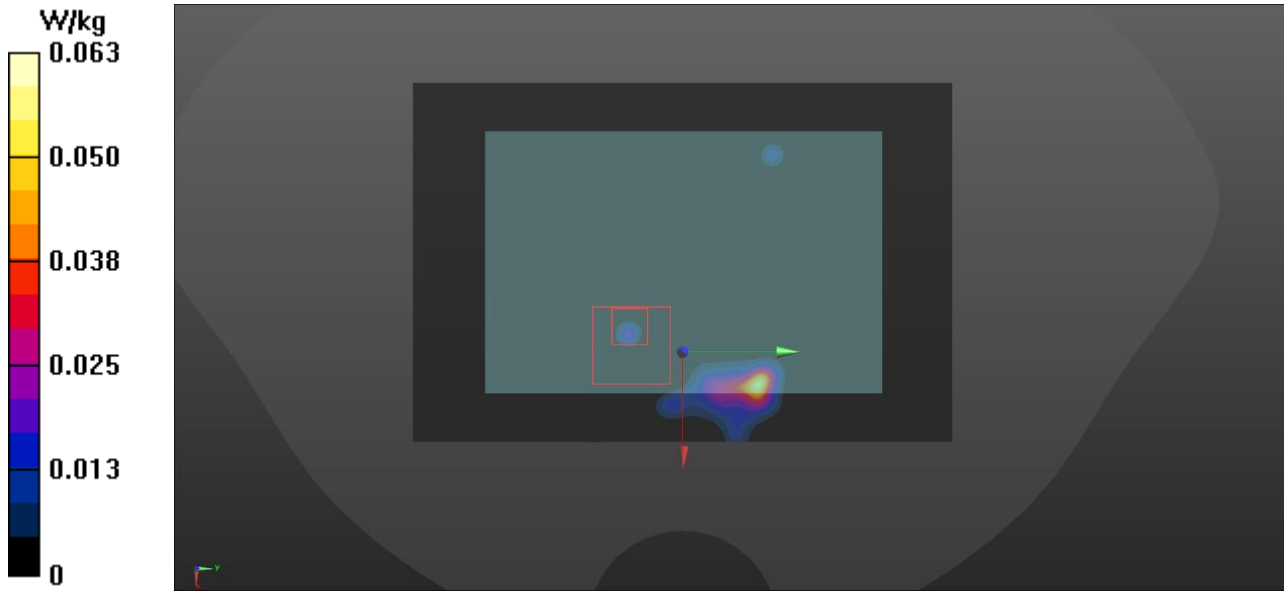
DUT: AINA Kepler

Communication System: UID 0, Bluetooth (0); Communication System Band: BLE; Frequency: 2480 MHz;
Communication System PAR: 4.771 dB;
Medium parameters used: f = 2480 MHz; σ = 1.878 S/m; ε_r = 39.832; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.77, 7.77, 7.77) @ 2480 MHz; Calibrated: 28/02/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn710; Calibrated: 14/10/2021
  - Phantom: Twin-SAM V4.0 (20deg probe tilt); Type: QD 000 P40 CC;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/BLE 2.4GHz, Back 0mm HIGH/Area Scan (151x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.0629 W/kg
Configuration/BLE 2.4GHz, Back 0mm HIGH/Zoom Scan (10x14x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.153 V/m; Power Drift = -10.72 dB
Peak SAR (extrapolated) = 0.0420 W/kg
SAR(1 g) = 0.017 W/kg; SAR(10 g) = 0.00768 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 = 41.6%
Maximum value of SAR (measured) = 0.0289 W/kg



Plot 11

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Date/Time: 15/08/2022 15:22:28

Test Laboratory: Verkotan Oy

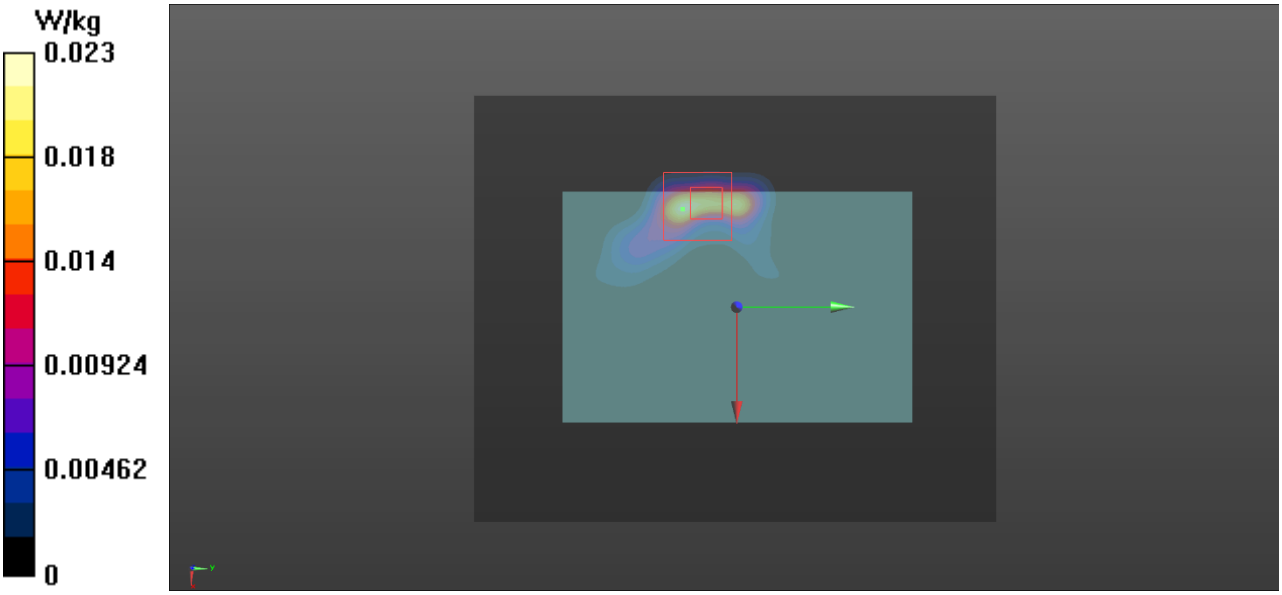
DUT: AINA Kepler

Communication System: UID 0, NFC 13.56MHz (0); Communication System Band: NFC; Frequency: 13.56 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 14 MHz; σ = 0.725 S/m; ε_r = 54.489; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(15.43, 15.43, 15.43) @ 13.56 MHz; Calibrated: 28/02/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 23/02/2022
  - Phantom: SAR1_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Configuration/Back 0mm NFC 13.56MHz/Area Scan (91x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0231 W/kg
Configuration/Back 0mm NFC 13.56MHz/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 0.8190 V/m; Power Drift = 0.50 dB
Peak SAR (extrapolated) = 0.0340 W/kg
SAR(1 g) = 0.00922 W/kg; SAR(10 g) = 0.00267 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 = 26.7%
Maximum value of SAR (measured) = 0.0178 W/kg



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APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION

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

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

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Accreditation No.: SCS 0108

Client Verkotan **Certificate No: EX3-7447_Feb22**

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: February 28, 2022

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
DAE4	SN: 660	13-Oct-21 (No. DAE4-660_Oct21)	Oct-22
Reference Probe ES3DV2	SN: 3013	27-Dec-21 (No. ES3-3013_Dec21)	Dec-22
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: 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-22

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

Issued: March 1, 2022

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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]	0.40	0.43	0.44	± 10.1 %
DCP (mV)[B]	93.5	95.0	96.2	

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	155.9	±2.5 %	± 4.7 %
		Y	0.0	0.0	1.0		167.3		
		Z	0.0	0.0	1.0		159.8		

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

[A] The uncertainties of Norm X,Y,Z do not affect the 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	15.43	15.43	15.43	0.00	1.00	± 13.3 %
750	41.9	0.89	10.39	10.39	10.39	0.42	0.80	± 12.0 %
900	41.5	0.97	9.90	9.90	9.90	0.45	0.80	± 12.0 %
1750	40.1	1.37	8.42	8.42	8.42	0.28	0.85	± 12.0 %
1950	40.0	1.40	8.13	8.13	8.13	0.26	0.85	± 12.0 %
2150	39.7	1.53	8.14	8.14	8.14	0.25	0.85	± 12.0 %
2300	39.5	1.67	8.09	8.09	8.09	0.21	0.90	± 12.0 %
2450	39.2	1.80	7.77	7.77	7.77	0.15	0.90	± 12.0 %
2600	39.0	1.96	7.61	7.61	7.61	0.24	0.90	± 12.0 %
3300	38.2	2.71	6.85	6.85	6.85	0.30	1.30	± 13.1 %
5250	35.9	4.71	5.20	5.20	5.20	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.50	4.50	4.50	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.60	4.60	4.60	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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Accreditation No.: SCS 0108

Client Verkotan

Certificate No: EX3-3852_Oct21

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3852

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

Calibration date: October 21, 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	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
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-22

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 23, 2021

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EX3DV4 – SN:3852

October 21, 2021

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3852

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.41	0.39	0.46	± 10.1 %
DCP (mV)[B]	100.3	100.7	98.7	

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	144.7	±2.5 %	± 4.7 %
		Y	0.0	0.0	1.0		136.0		
		Z	0.0	0.0	1.0		132.6		

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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EX3DV4– SN:3852

October 21, 2021

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3852

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)
30	55.0	0.75	13.53	13.53	13.53	0.00	1.00	± 13.3 %
64	54.2	0.75	12.08	12.08	12.08	0.00	1.00	± 13.3 %
128	52.8	0.76	11.62	11.62	11.62	0.00	1.00	± 13.3 %
220	49.0	0.81	11.12	11.12	11.12	0.00	1.00	± 13.3 %
450	43.5	0.87	10.16	10.16	10.16	0.16	1.30	± 13.3 %
1300	40.8	1.14	8.79	8.79	8.79	0.27	0.80	± 12.0 %
1450	40.5	1.20	8.68	8.68	8.68	0.33	0.80	± 12.0 %
1640	40.2	1.31	8.48	8.48	8.48	0.26	0.86	± 12.0 %
3500	37.9	2.91	6.90	6.90	6.90	0.30	1.35	± 13.1 %
3700	37.7	3.12	6.70	6.70	6.70	0.30	1.35	± 13.1 %
3900	37.5	3.32	6.44	6.44	6.44	0.40	1.60	± 13.1 %
4100	37.2	3.53	6.25	6.25	6.25	0.40	1.60	± 13.1 %
5250	35.9	4.71	4.90	4.90	4.90	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.61	4.61	4.61	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.69	4.69	4.69	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

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

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Accreditation No.: SCS 0108

Client Verkotan **Certificate No: CLA13-1012_Mar21**

CALIBRATION CERTIFICATE

Object	CLA13 - SN: 1012
Calibration procedure(s)	QA CAL-15.v9 Calibration Procedure for SAR Validation Sources below 700 MHz
Calibration date:	March 11, 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
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 3877	30-Dec-20 (No. EX3-3877_Dec20)	Dec-21
DAE4	SN: 654	26-Jun-20 (No. DAE4-654_Jun20)	Jun-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 Agilent 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 12, 2021

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Accreditation No.: SCS 0108

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

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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	13 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	55.0	0.75 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	53.8 ± 6 %	0.72 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	1 W input power	0.540 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**0.555 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	0.337 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**0.346 W/kg ± 18.0 % (k=2)**

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω + 5.4 jΩ
Return Loss	- 23.4 dB

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL

Date: 11.03.2021

Test Laboratory: SPEAG, Zurich, Switzerland

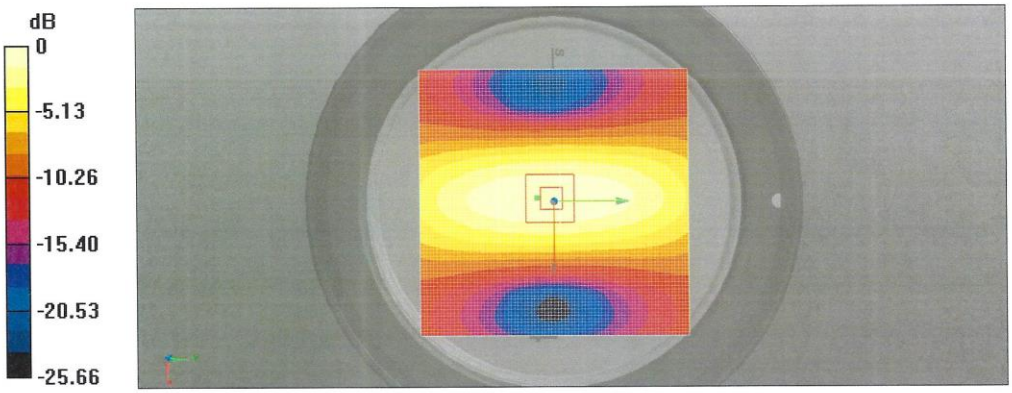
DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1012

Communication System: UID 0 - CW; Frequency: 13 MHz
Medium parameters used: f = 13 MHz; σ = 0.72 S/m; ε_r = 53.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(15.33, 15.33, 15.33) @ 13 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.06.2020
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

CLA Calibration for HSL-LF Tissue/CLA-13, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 30.71 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.09 W/kg
SAR(1 g) = 0.549 W/kg; SAR(10 g) = 0.337 W/kg
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 30mm)
Ratio of SAR at M2 to SAR at M1 = 78.3%
Maximum value of SAR (measured) = 0.789 W/kg



0 dB = 0.789 W/kg = -1.03 dBW/kg

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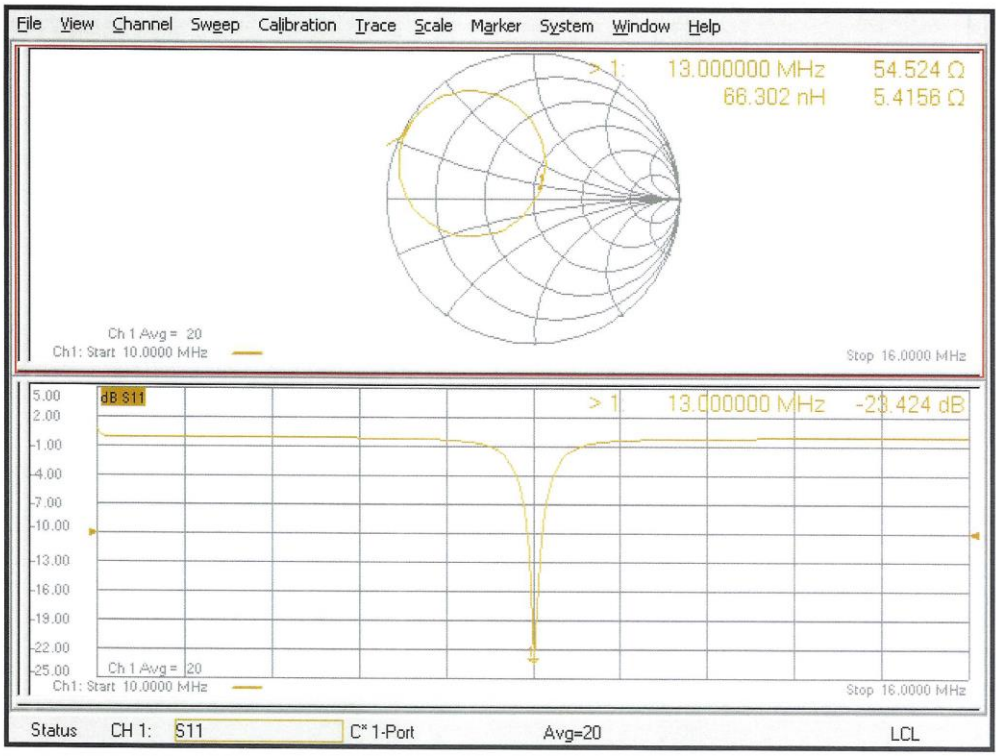
Impedance Measurement Plot for Head TSL



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Accreditation No.: SCS 0108

Client Verkotan

Certificate No: D2450V2-729_Jul22

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:729
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	July 15, 2022

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	02-May-22 (No. DAE4-601_May22)	May-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

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

Issued: July 19, 2022

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Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 16.5 % (k=2)**

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω + 0.8 jΩ
Return Loss	- 30.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.147 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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SAR Reference Dipole Calibration Report

Ref : ACR.84.7.20.MVGB.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
SAR REFERENCE DIPOLE
FREQUENCY: 5000 MHZ
SERIAL NO.: SN 1014

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

ilac-MRA cofrac ETALONNAGE

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

0.0Summary:

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 %.	
5000-6000	20.6±1 %.	-	40.3 ±1 %.	-	d1 - 3.6 ±1 %. d2 – 2.1 ±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 5250 MHz: eps' :35.64 sigma : 4.67 Head Liquid Values 5600 MHz: eps' :36.66 sigma : 5.17 Head Liquid Values 5750 MHz: eps' :35.31 sigma : 5.21
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5250 MHz 5600 MHz 5750 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,')		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 %	

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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 %	
3500	37.9 ±10 %		2.91 ±10 %	
5000	36.2 ±10 %		4.45 ±10 %	
5100	36.1 ±10 %		4.56 ±10 %	
5200	36.0 ±10 %		4.66 ±10 %	
5300	35.9 ±10 %		4.76 ±10 %	
5400	35.8 ±10 %		4.86 ±10 %	
5500	35.6 ±10 %		4.97 ±10 %	
5600	35.5 ±10 %	36.66	5.07 ±10 %	5.17
5700	35.4 ±10 %		5.17 ±10 %	
5800	35.3 ±10 %		5.27 ±10 %	
5900	35.2 ±10 %		5.38 ±10 %	
6000	35.1 ±10 %		5.48 ±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	

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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	
3500	67.1		25	
5200	76.5		21.6	
5250	-	77.65 (7.77)	-	22.22 (2.22)
5500	83.3		23.4	
5600	-	83.31 (8.33)	-	24.02 (2.40)
5750	-	75.18 (7.52)	-	21.96 (2.20)
5800	78.0		21.9	

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