SAR Compliance Test Report

Date of Report	27/04/2017	**Client's Contact person:**	Gabriele Isola
Number of pages:	31		
		Responsible Test engineer:	Ilpo Joensuu
Testing laboratory:	Verkotan Oy Elektroniikkatie 17 90590 Oulu Finland	**Client:**	CAEN RFID srl Via Vetraia, 11 55049 Viareggio (LU) Italy

Tested device	**R1170IU**
Related reports:	-
Testing has been carried out in accordance with:	**47CFR §2.1093** Radiofrequency Radiation Exposure Evaluation: Portable Devices **FCC published RF exposure KDB procedures** **IEEE 1528 - 2013** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Technique
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:

27.04.2017

For the contents:

Miia Nurkkala Digitally signed by Miia Nurkkala
Date: 2017.04.27 10:54:32 +03'00'

Laboratory Manager

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (EUT):

Product:	R1170IU qIDmini Keyfob Bluetooth UHF RFID Reader
Manufacturer:	CAEN RFID
Serial Number:	0674045316451124, 0674045316381063
FCC ID Number:	UVECAENRFID017
Hardware Version:	HW 0203
DUT Number:	23117, 23118
Battery Type used in testing:	Li-Ion 3.7V, 570mAh
Portable/ Mobile device	Portable
State of the Sample	Production sample

Testing information:

Testing performed:	2.2-3.2.2017, 21.4.2017
Notes:	
Document name:	FCC SAR report_UVECAENRFID017_27042017.docx
Temperature °C	22±2 / Controlled
Humidity RH%	20±20 / Controlled
Measurement performed by:	Ilpo Joensuu, Kirsi Kyllönen

1.2 Maximum Results

The maximum reported* SAR value for Body-worn configuration with 3 mm separation distance is shown in a table below. The device conforms to the requirements of the standards when the maximum reported SAR value is less than or equal to the limit. The SAR limit specified in FCC 47 CFR part 2 (2.1093) for Body is SAR_{1g} 1.6 W/kg,

Equipment Class	System	Highest Reported* SAR_{1g}(W/kg) in Body-Worn Condition	Result
DSS	**UHF RFID**	0.76	**PASS**

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

1.2.1 Maximum Drift

Maximum Drift During Measurements	-0.52*

*Drifts >0.2dB have been considered in the scaling factor

1.2.2 Measurement Uncertainty

Expanded Uncertainty (k=2) 95 %	23.4%

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is a handheld RFID reader. The DUT can be used in a body-worn configuration with a lanyard. Body-worn configuration SAR is tested in this report.

Device Category	Portable
Exposure Environment	Uncontrolled

2.1 Supported Frequency Bands and Operational Modes

	Modes of Operation	Transmitter Frequency Range (MHz)
TX Frequency bands	RFID	**902.75 - 927.25**
	BLuetooth	**2402-2480**

Common features	
RFID Duty Cycle	31.5%
Battery	Li-Ion 3.7V, 570mAh
Size	(W)99 x (L)54 x (H)20 mm^3 max
RFID Antenna type	Integrated UHF loop antenna

2.2 Simultaneous Transmission possibilities

Bluetooth and RFID can not transmit simultaneously.

2.3 Test exlusions

The maximum peak conducted power from the BLUETOOTH module (FCC ID: T9J-RN42) is 4mW so the SAR exclusion threshold (Appendix A of KDB 447498 D01) for 5mm separation distance is not exceeded. Thus, Bluetooth SAR is not measured.

3. OUTPUT POWER

3.1 Maximum output power

From a Customer;

Mode	Upper Limit Power (dBm)		
	CH 0 902.75 GHz	CH 25 915.25 GHz	CH 49 927.25 GHz
RFID	23.5	23.0	22.5

3.2 Tested conducted power

Mode	Power (dBm)		
	CH 0 902.75 GHz	CH 25 915.25 GHz	CH 49 927.25 GHz
RFID	23.18	22.57	21.67

4. TEST EQUIPMENT

Dasy4 and 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.

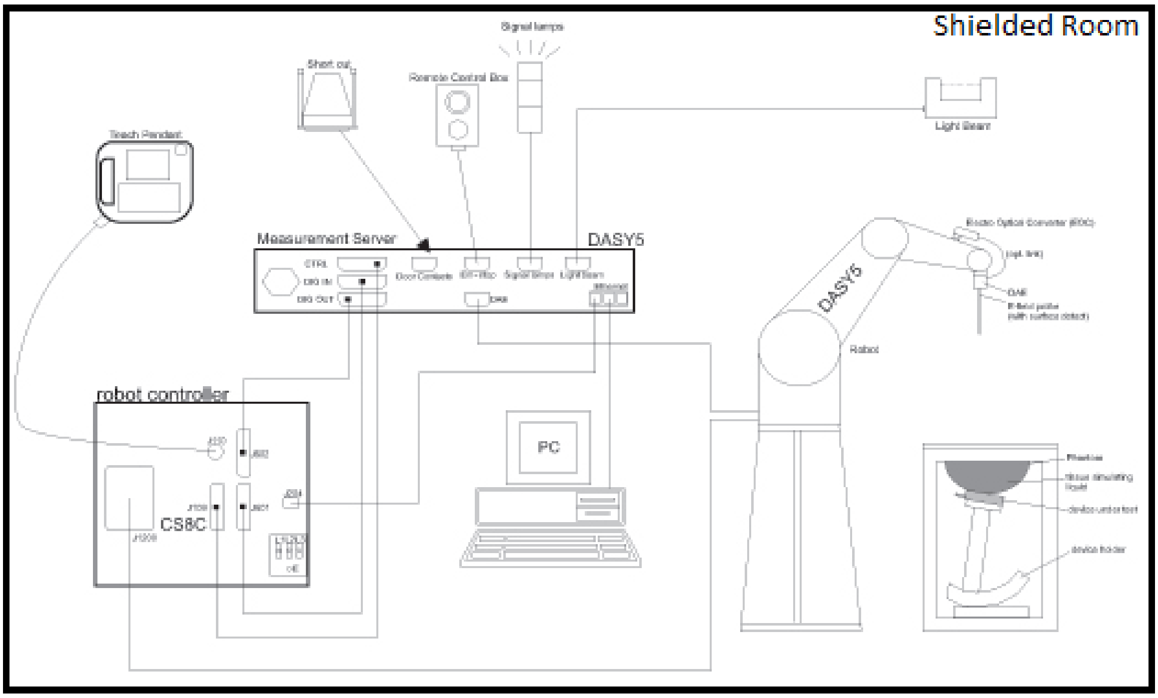


Figure 1 Schematic Laboratory Picture

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	Calibration Expiry
DAE	DAE4	710	01/2017	01/2018
DAE	DAE3	371	04/2016	04/2017
Probe	EX3DV4	7447	03/2017	03/2018
Probe	EX3DV4	3892	03/2016	03/2017
Dipole	D835V2	448	01/2016	01/2019
DASY4 Software	v4.7	na	na	na
DASY5 Software	52.8.8.1258	na	na	na
Signal Generator	SMIQ06B	834968/023	na	na
Amplifier	AR 5S1G4	27573	na	na
Power Reflection Meter	R&S NRT	835065/049	01/2017	01/2018
Power Sensor	NRT Z-44	835374/021	01/2017	01/2018

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

4.2 Phantoms

The phantom used in SAR tests was the flat phantom section of the twin-headed "SAM Phantom" and modular flat phantom manufactured by SPEAG. The phantoms 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 ±5% of the recommended values in all frequencies used. SAR testing was carried out within 24 hours of measuring the dielectric parameters. Depth of the tissue simulant was at least 15.0 cm from the inner surface of the flat phantom.

4.3.1 Recipes

Ingredient	**Body (% by weight)**
	835 MHz
Deionised Water	69.25
Tween 20	30.0
Salt	0.75

4.4 System Validation Status

Frequency [MHz]	**Dipole Type / SN**	**Probe Type / SN**	**Calibrated Signal Type**	**DAE Unit / SN**	**Validation Done**
					Body tissue simulant
835	D835	EX3DV4 / 3892	CW	DAE3 / 371	02/2017
835	D835	EX3DV4 / 7447	CW/GMSK	DAE4/710	04/2017

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]	$Deviation_{1g}$ (%)	Plot #
02.02.2017	B835	22	835	250mW	2.54	9.55	10.16	6.4	1
21.04.2017	B835	22	835	250mW	2.52	9.55	10.08	5.6	2

4.5.1 Tissue Simulant Verification

				Target		Measured			
Date	**Tissue Type**	**Tissue Temp. [°C]**	**Frequency [MHz]**	**Conductivity, σ [S/m]**	**Dielectric Constant [ε]**	**Conductivity σ [S/m]**	**Dielectric Constant [ε]**	**Deviation σ (%)**	**Deviation ε (%)**
02.02.2017	B835	22	835	0.98	55.2	1.02	54.32	4.1	-1.6
			902.75	1.05	55	1.06	54.06	1.0	-1.7
			915.25	1.06	55	1.07	54.01	0.9	-1.8
			927.25	1.06	55	1.06	53.96	0	-1.9
21.04.2017	B835	22	835	0.98	55.2	1.01	54.8	3.1	0.7
			915.25	1.06	55	1.06	54.4	0	1.1

5. TEST PROCEDURE

The DUT was set to transmit continuously at a maximum power level using a manufacturer specified software.

5.1.1 *Body-worn Configuration*, 3 mm separation distance

The DUT was placed below the flat phantom using a SPEAG device holder. The DUT was lifted towards the phantom until correct separation distance was reached. Pictures of the test positions are in appendix A.

5.2 Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan with 7x7x7 points covering a volume of 30x30x30mm 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 is averaged over a cube of tissue using interpolation and extrapolation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at dierent distances are necessary for the extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy47 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).

6. MEASUREMENT UNCERTAINTY

Uncertainty Budget
IEEE 1528-2013

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

7. TEST RESULTS

7.1 Body-Worn Configuration, 3 mm separation distance

Band	Channel	Test Position*	Maximun Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Measurement Dudy Cycle	Normal Mode Dudy Cycle	Measured SAR_{1g} [mW/g]	Time averaged SAR_{1g} [mW/g]	Scaling Factor	Reported SAR_{1g} [mW/g]	Plot #
UHF	25	front	23	22.57	-0.058	1	1:3.17	1.56	0.49	1.10	0.54	3
UHF	25	back	23	22.57	0.0266	1	1:3.17	2.18	0.69	1.10	0.76	
UHF	25	top	23	22.57	-0.05	1	1:3.17	0.446	0.14	1.10	0.15	4
UHF	25	bottom	23	22.57	-0.52*	1	1:3.17	0.0142	0.004	1.24	0.01	5
UHF	25	right	23	22.57	-0.15	1	1:3.17	0.144	0.05	1.10	0.05	6
UHF	25	left	23	22.57	-0.15	1	1:3.17	0.384	0.12	1.10	0.13	7
UHF	0	front	23.5	23.18	-0.455*	1	1:3.17	1.31	0.41	1.20	0.49	
UHF	0	back	23.5	23.18	-0.0533	1	1:3.17	2.02	0.64	1.08	0.69	
UHF	49	front	22.5	21.67	-0.382*	1	1:3.17	1.2	0.38	1.32	0.50	
UHF	49	back	22.5	21.67	-0.251*	1	1:3.17	1.98	0.62	1.21	**0.76**	8

*Drift considered in the scaling factor

*Pictures of the test position are presented in appendix A.

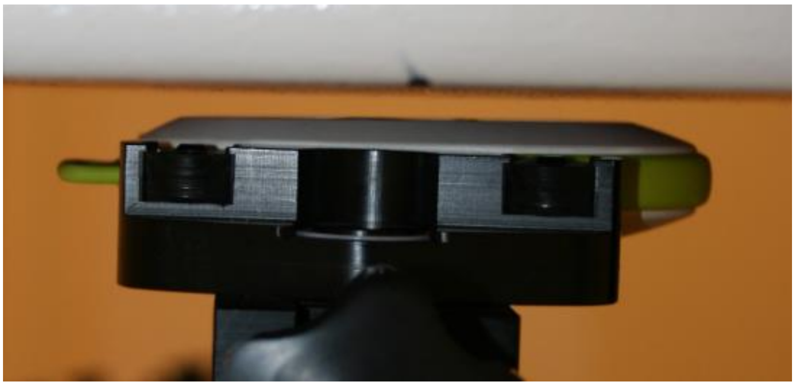
APPENDIX A: PHOTOS OF THE DUT

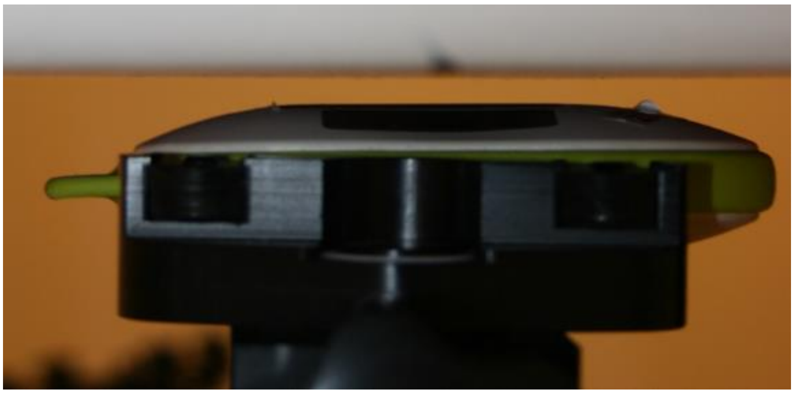
Top

Left

Right

Bottom


Front toward phantom


Back towards phantom


Left side towards phantom

Right side towards phantom

Bottom towards phantom

Top towards phantom

APPENDIX B: SYSTEM CHECK SCAN

Date/Time: 2.2.2017 16:52:56

Test Laboratory: Verkotan Oy

02022017_body_SystemPerformanceCheck-D835 Plot 1

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:448

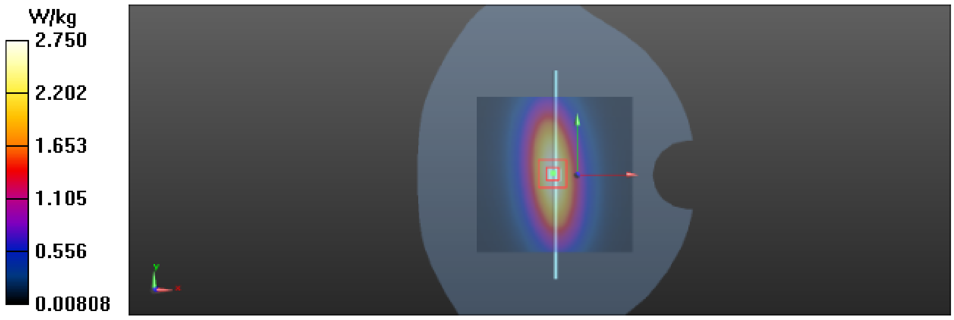
Communication System: UID 0, CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.017 S/m; ε_r = 54.316; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.54, 9.54, 9.54); Calibrated: 11.3.2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn371; Calibrated: 22.4.2016
- Phantom: SAM_2; Type: SAM Twin; Serial: TP-1142
- DASY52 4.7.80(0); SEMCAD X 14.6.10(7373)

Configuration/d=10mm, Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 52.17 V/m; Power Drift = -0.06 dB
Fast SAR: SAR(1 g) = 2.56 W/kg; SAR(10 g) = 1.72 W/kg
Maximum value of SAR (interpolated) = 2.75 W/kg

Configuration/d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.17 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 3.77 W/kg
SAR(1 g) = 2.54 W/kg; SAR(10 g) = 1.67 W/kg
Maximum value of SAR (measured) = 2.74 W/kg



Plot 2

Date/Time: 21.4.2017 12:54:01

Test Laboratory: Verkotan Oy

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:448

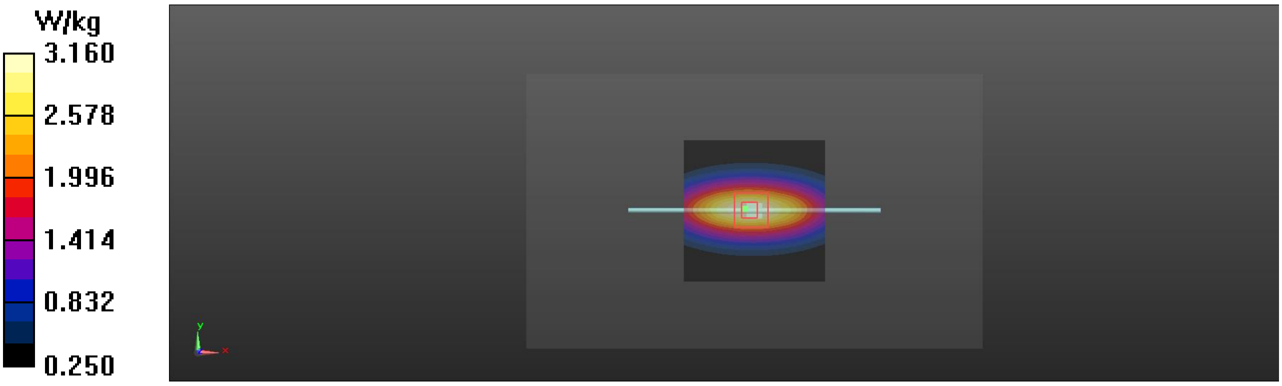
Communication System: UID 0, CW (0); Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 835 MHz; σ = 1.012 S/m; ε_r = 54.759; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(10.23, 10.23, 10.23); Calibrated: 6.3.2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn710; Calibrated: 25.1.2017
- Phantom: SAR1_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 28_March_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

System Check CW 835MHz Pin=250 mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.23 W/kg

System Check CW 835MHz Pin=250 mW/Zoom Scan (7x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.71 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.70 W/kg
SAR(1 g) = 2.52 W/kg; SAR(10 g) = 1.66 W/kg
Maximum value of SAR (measured) = 3.16 W/kg



APPENDIX C: MEASUREMENT SCAN

Date/Time: 3.2.2017 9:45:23

Test Laboratory: Verkotan Oy

Plot 3

CaenRFID_03022017

DUT: qIDmini; Type: RFID Reader; Serial: 0674045316451124

Communication System: UID 0, RFID; Frequency: 915.25 MHz
Medium parameters used (interpolated): f = 915.25 MHz; σ = 1.066 S/m; ε_r = 54.005; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

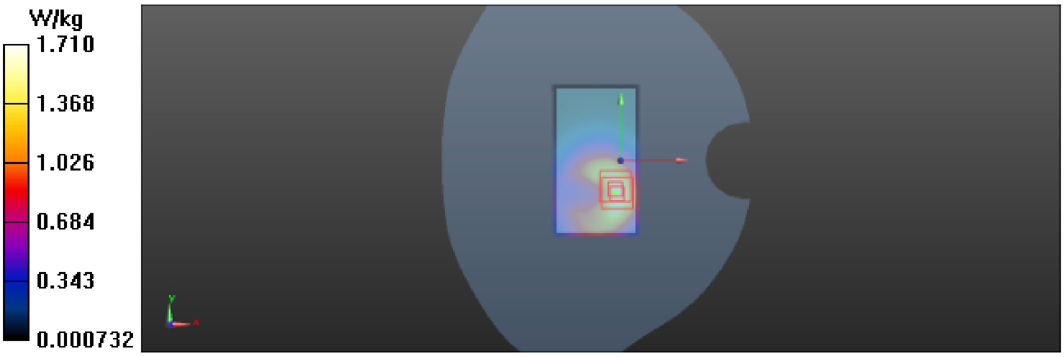
- Probe: EX3DV4 - SN3892; ConvF(9.54, 9.54, 9.54); Calibrated: 11.3.2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = -49.0, 31.0
- Electronics: DAE3 Sn371; Calibrated: 22.4.2016
- Phantom: SAM_2; Type: SAM Twin; Serial: TP-1142
- DASY52 4.7.80(0); SEMCAD X 14.6.10(7373)

Configuration/Front 3mm/Area Scan (41x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 30.44 V/m; Power Drift = -0.06 dB
Fast SAR: SAR(1 g) = 1.54 W/kg; SAR(10 g) = 0.979 W/kg

Maximum value of SAR (interpolated) = 1.71 W/kg

Configuration/Front 3mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 30.44 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 2.58 W/kg
SAR(1 g) = 1.56 W/kg; SAR(10 g) = 0.922 W/kg

Maximum value of SAR (measured) = 1.68 W/kg



Plot 4

Date/Time: 21.4.2017 16:09:45

Test Laboratory: Verkotan Oy

DUT: qIDmini; Type: RFID; Serial: 0674045316451124

Communication System: UID 0, CW (0); Communication System Band: RFID; Frequency: 915.25 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 915.25 MHz; σ = 1.062 S/m; ε_r = 54.396; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(10.23, 10.23, 10.23); Calibrated: 6.3.2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn710; Calibrated: 25.1.2017
- Phantom: SAR1_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 28_March_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

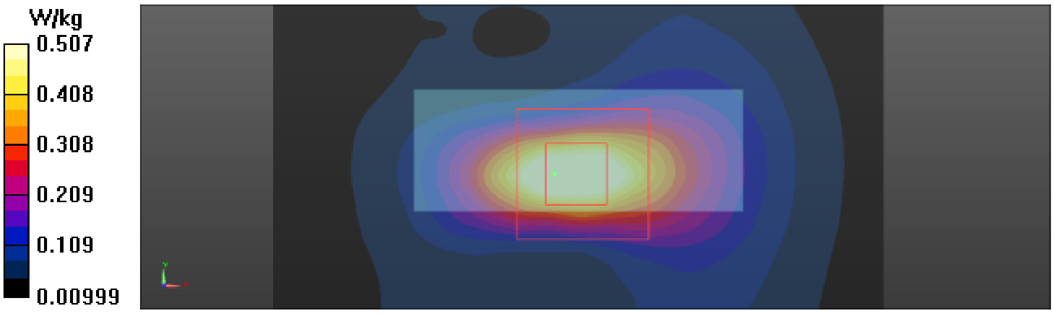
Configuration/Top side 3mm Mid 2 2 2/Area Scan (101x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.597 W/kg

Configuration/Top side 3mm Mid 2 2 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 20.64 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.916 W/kg
SAR(1 g) = 0.446 W/kg; SAR(10 g) = 0.214 W/kg

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.507 W/kg



Date/Time: 21.4.2017 15:56:16

Test Laboratory: Verkotan Oy

DUT: qIDmini; Type: RFID; Serial: 0674045316451124

Communication System: UID 0, CW (0); Communication System Band: RFID; Frequency: 915.25 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 915.25 MHz; σ = 1.062 S/m; ε_r = 54.396; ρ = 1000 kg/m^3
Phantom section: Right Section

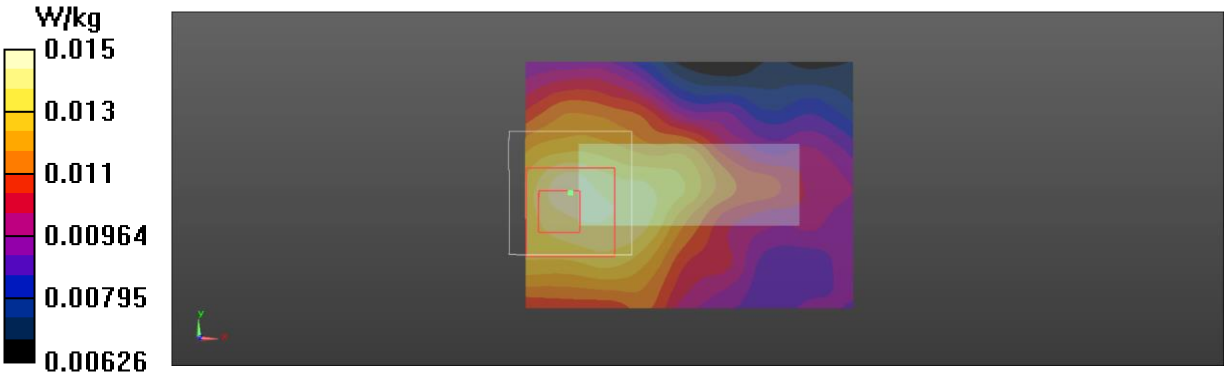
DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(10.23, 10.23, 10.23); Calibrated: 6.3.2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 31.0
- Electronics: DAE4 Sn710; Calibrated: 25.1.2017
- Phantom: SAR1_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 28_March_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Bottom side 3mm Mid 2 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 3.443 V/m; Power Drift = -0.52 dB
Peak SAR (extrapolated) = 0.0220 W/kg
SAR(1 g) = 0.014 W/kg; SAR(10 g) = 0.00654 W/kg
Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.0180 W/kg

Configuration/Bottom side 3mm Mid 2 2/Area Scan (81x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0147 W/kg



Plot 6

Date/Time: 21.4.2017 14:11:17

Test Laboratory: Verkotan Oy

DUT: qIDmini; Type: RFID; Serial: 0674045316451124

Communication System: UID 0, CW (0); Communication System Band: RFID; Frequency: 915.25 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 915.25 MHz; σ = 1.062 S/m; ε_r = 54.396; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY Configuration:

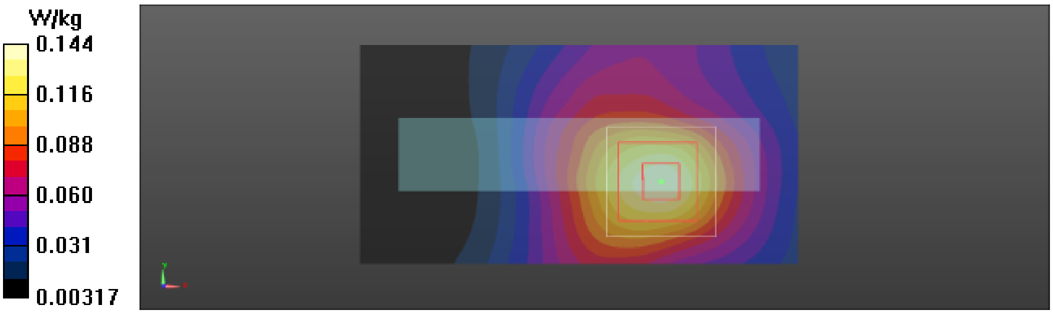
- Probe: EX3DV4 - SN7447; ConvF(10.23, 10.23, 10.23); Calibrated: 6.3.2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 31.0
- Electronics: DAE4 Sn710; Calibrated: 25.1.2017
- Phantom: SAR1_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 28_March_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Right side 3mm Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 8.971 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.205 W/kg
SAR(1 g) = 0.144 W/kg; SAR(10 g) = 0.093 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.160 W/kg

Configuration/Right side 3mm Mid/Area Scan (81x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.144 W/kg



Plot 7

Date/Time: 21.4.2017 16:45:08

Test Laboratory: Verkotan Oy

DUT: qIDmini; Type: RFID; Serial: 0674045316451124

Communication System: UID 0, CW (0); Communication System Band: RFID; Frequency: 915.25 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 915.25 MHz; σ = 1.062 S/m; ε_r = 54.396; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY Configuration:

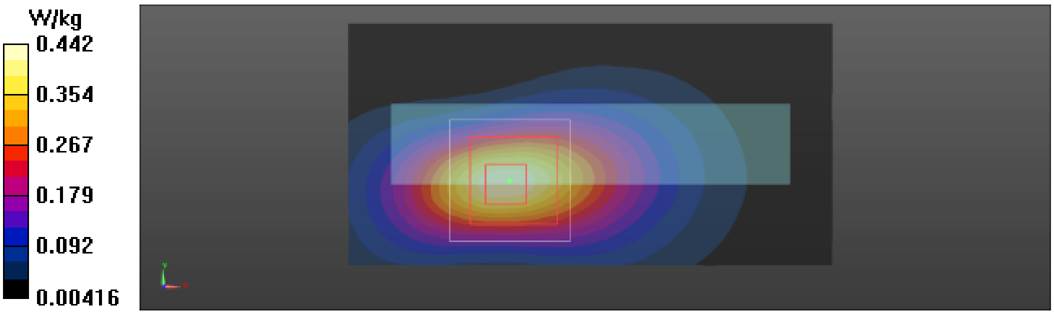
- Probe: EX3DV4 - SN7447; ConvF(10.23, 10.23, 10.23); Calibrated: 6.3.2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 31.0
- Electronics: DAE4 Sn710; Calibrated: 25.1.2017
- Phantom: SAR1_Phantom 1_triple flat; Type: QD 000 P51 Cx; Serial: 28_March_2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/Left side 3mm Mid 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 14.34 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.647 W/kg
SAR(1 g) = 0.384 W/kg; SAR(10 g) = 0.222 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.425 W/kg

Configuration/Left side 3mm Mid 2/Area Scan (121x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.442 W/kg



Date/Time: 3.2.2017 14:26:59

Test Laboratory: Verkotan Oy

DUT: qIDmini; Type: RFID Reader; Serial: 0674045316451124

Plot 8

Communication System: UID 0, RFID; Frequency: 927.25 MHz
Medium parameters used (interpolated): f = 927.25 MHz; σ = 1.064 S/m; ε_r = 53.955; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(9.54, 9.54, 9.54); Calibrated: 11.3.2016;
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn371; Calibrated: 22.4.2016
- Phantom: SAM_2; Type: SAM Twin; Serial: TP-1142
- DASY52 4.7.80(0); SEMCAD X 14.6.10(7373)

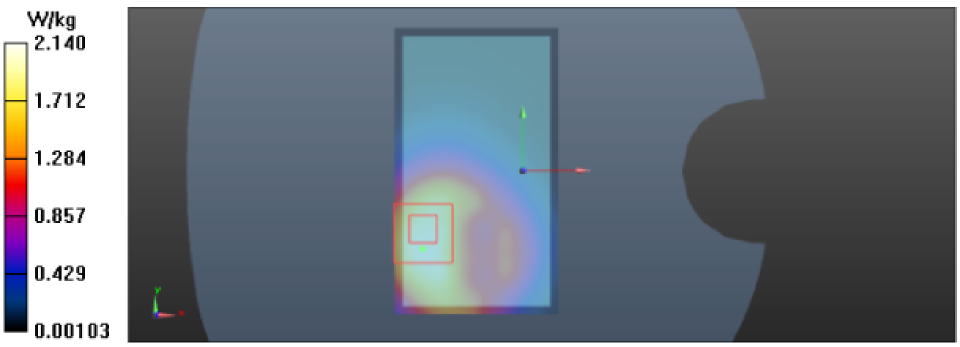
Configuration/Back 3mm 3/Area Scan (41x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 2.14 W/kg

Configuration/Back 3mm 3/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.63 V/m; Power Drift = -0.25 dB
Peak SAR (extrapolated) = 3.64 W/kg
SAR(1 g) = 1.98 W/kg; SAR(10 g) = 1.12 W/kg

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 2.18 W/kg



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T287 (EN ISO/IEC 17025)

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 **TCC Microsoft**

Certificate No: **EX3-3892_Mar16**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3892

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: March 11, 2016

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 E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Leif Klysner
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 12, 2016

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

Certificate No: EX3-3892_Mar16   Page 1 of 11

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.50	0.40	0.49	± 10.1 %
DCP (mV)[B]	102.2	104.7	101.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	137.0	±3.8 %
		Y	0.0	0.0	1.0		142.9	
		Z	0.0	0.0	1.0		137.5	

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 Pages 5 and 6).
[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.

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	9.70	9.70	9.70	0.50	0.82	± 12.0 %
835	55.2	0.97	9.54	9.54	9.54	0.33	1.01	± 12.0 %
1750	53.4	1.49	7.91	7.91	7.91	0.39	0.88	± 12.0 %
1900	53.3	1.52	7.62	7.62	7.62	0.33	0.86	± 12.0 %
2300	52.9	1.81	7.40	7.40	7.40	0.34	0.80	± 12.0 %
2450	52.7	1.95	7.35	7.35	7.35	0.31	0.80	± 12.0 %
2600	52.5	2.16	7.05	7.05	7.05	0.17	0.80	± 12.0 %
5250	48.9	5.36	4.13	4.13	4.13	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.76	3.76	3.76	0.55	1.90	± 13.1 %
5750	48.3	5.94	3.86	3.86	3.86	0.55	1.90	± 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. 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.

Verkotan

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
C 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_Mar17

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7447
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	March 6, 2017

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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 660	7-Dec-16 (No. DAE4-660_Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 14, 2017

EX3DV4– SN:7447

March 6, 2017

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	10.35	10.35	10.35	0.45	0.86	± 12.0 %
900	41.5	0.97	9.66	9.66	9.66	0.33	0.99	± 12.0 %
1750	40.1	1.37	8.80	8.80	8.80	0.33	0.80	± 12.0 %
1900	40.0	1.40	8.46	8.46	8.46	0.31	0.80	± 12.0 %
2100	39.8	1.49	8.45	8.45	8.45	0.29	0.80	± 12.0 %
2300	39.5	1.67	8.17	8.17	8.17	0.26	0.80	± 12.0 %
2450	39.2	1.80	7.76	7.76	7.76	0.33	0.80	± 12.0 %
2600	39.0	1.96	7.60	7.60	7.60	0.30	0.91	± 12.0 %
5250	35.9	4.71	5.35	5.35	5.35	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.56	4.56	4.56	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.80	4.80	4.80	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. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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

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

APPENDIX E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS

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
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: **D835V2-448_Jan16**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 448
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 15, 2016

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 EPM-442A	GB37480704	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 15, 2016

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

Certificate No: D835V2-448_Jan16 Page 1 of 8

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.27 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.01 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.2 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.55 W/kg ± 17.0 % (k=2)**

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

Dipole D835V2 – SN: 448 Antenna Parameters measured: 2017-04-05.

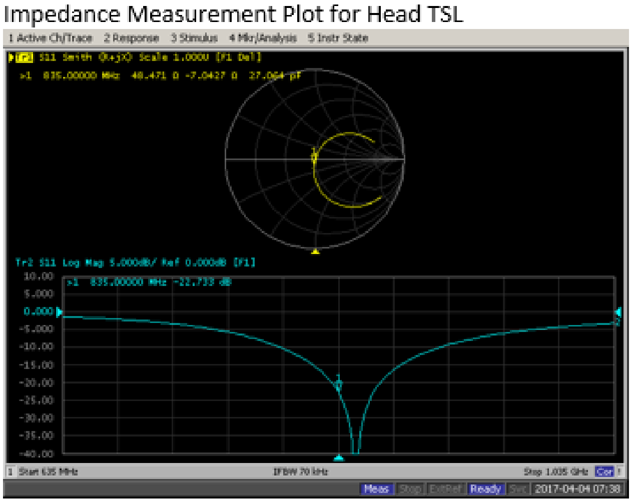
Antenna Parameters with Head TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	49.6 Ω - 7.3 jΩ	48.5 Ω - 7.0 jΩ
Return loss	- 22.70 dB	- 22.73 dB

Antenna Parameters with Body TSL

	Calibration certificate	Annual measurement
Impedance, transformed to feed point	45.9 Ω - 8.4 jΩ	44.0 Ω - 7.0 jΩ
Return loss	- 22.30 dB	- 20.19 dB

Impedance Measurement Plot for Head TSL



Impedance Measurement Plot for Body TSL