SAR Compliance Test Report

Date of Report	21/12/2017	**Client's Contact person:**	Rauno Nikkilä
Number of pages:	25	**Responsible Test engineer:**	Kirsi Kyllönen
Testing laboratory:	Verkotan Oy Elektroniikkatie 17 90590 Oulu Finland	**Client:**	NORDIC ID GROUP Joensuunkatu 7 24100 Salo, FINLAND tel. +358 2 727 7700
Tested device	**EXA51e, Model 818-3A**		
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:

21.12.2017

For the contents:

Miia Nurkkala

Digitally signed by Miia Nurkkala
Date: 2017.12.21 08:47:23 +02'00'

Laboratory Manager

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Equipment under Test (EUT):

Product:	NORDIC ID EXA51e, Model 818-3A
Manufacturer:	NORDIC ID GROUP
Serial Number:	K174000227, K173700219
FCC ID Number:	SCCNUR21W
Hardware Version:	BLE818_2#3_NUR2-1W_1#3
DUT Number:	22949, 22950
Battery Type used in testing:	Lithium-Ion battery pack 7000 mAh, 3.7V
Portable/ Mobile device	Portable
State of the Sample	Production sample

Testing information:

Testing Performed:	8-9.11.2017
Notes:	EXA51e, Model: 818-3A incorporates FCC certified RFID module NUR2-1W with FCC ID SCCNUR21W (main module) and BLE module MDBT42Q with FCC ID SH6MDBT42Q.
Document ID:	FCC SAR Report_EXA51e_ID2470_211217.docx
Temperature °C	22±2 / Controlled
Humidity RH%	20±20 / Controlled
Measurement performed by:	Kirsi Kyllönen

1.2 Maximum Results

The maximum reported* SAR value for Body-worn configuration with 20 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, JBP	UHF RFID	1.05	**PASS**

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

1.2.1 Maximum Drift

Maximum Drift During Measurements	0.73*

*Drifts >5% 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 that can be connected to a smart device via Bluetooth Low Energy.

Device Category	Portable
Exposure Environment	Uncontrolled

2.1 Supported Frequency Bands and Operational Modes

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

The DUT has Software controlled antenna modes: linear (horizontal & vertical), circular and proximity. The corresponding reading distances are: linear polarization mode 10 m/33 ft, circular polarization mode 6 m/20 ft, proximity mode, read range down to 1 cm/0.4 inch. Linear mode has the largest antenna gain thus linear horizontal mode was selected for SAR testing.

2.2 Simultaneous Transmission Possibilities

Bluetooth and RFID can transmit simultaneously.

2.2.1 Test Exclusions

Due to the low power and distance from the RFID transmitter, there should be minimal overlap of the SAR distributions from the BT and RFID transmitters. As a result of manufactures KDB inquiry, Bluetooth test is excluded.

3. OUTPUT POWER

3.1 Maximum Output Power

From a Customer;

Mode	Upper Limit Peak Power (dBm)		
	CH 1 902.75 MHz	CH 25 914.75 MHz	CH 50 927.25 MHz
RFID	30	30	30

3.2 Tested conducted power

Mode	Measured Peak Power (dBm)		
	CH 1 902.75 GHz	CH 25 914.75 GHz	CH 50 927.25 GHz
RFID	27.3	27.47	27.01

Mode	Measured Average Power (dBm)		
	CH 1 902.75 GHz	CH 25 914.75 GHz	CH 50 927.25 GHz
RFID	25.1	25.0	25.2

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.

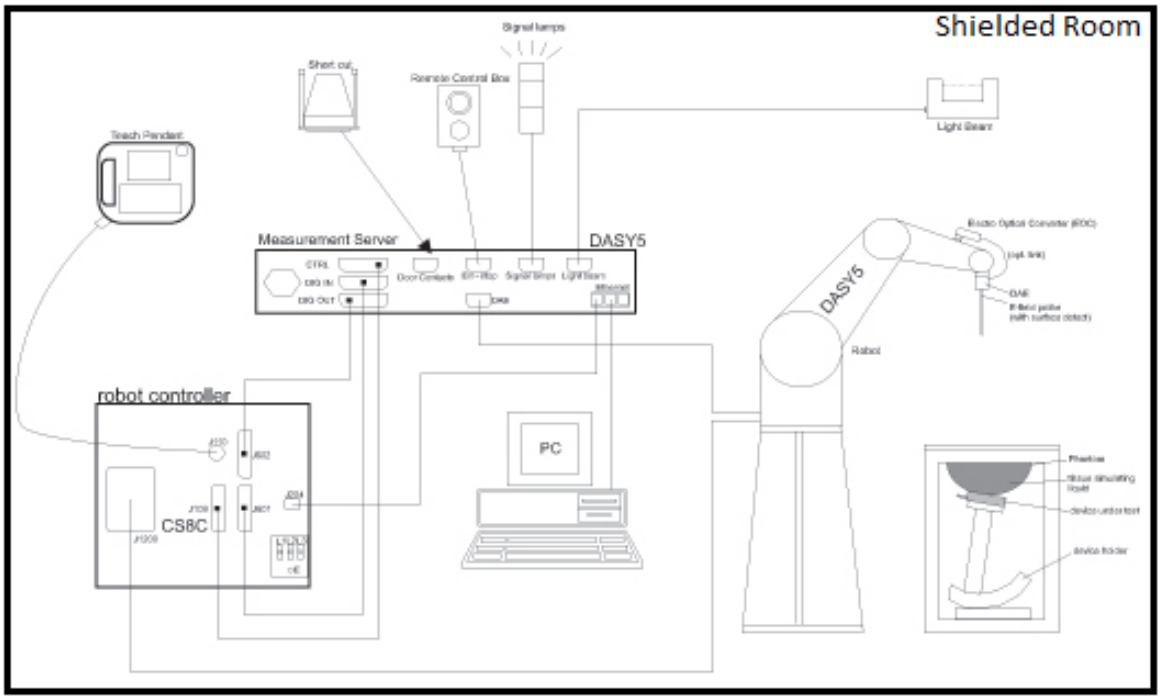


Figure 1 Schematic Laboratory Picture

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	756	01/2017	01/2018
Probe	EX3DV4	3892	4/2017	04/2018
Dipole	D835V2	455	06/2017	06/2020
DASY5 Software	52.8.8.1258	na	na	na
Signal Generator	SMIQ06B	834968/023	na	na
Amplifier	AR 10S1G4A	320421	na	na
Power Reflection Meter	R&S NRT	835065/049	01/2017	01/2018
Power Sensor	NRT Z44	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 an ELI phantom, manufactured by SPEAG. ELI phantom is used for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids

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 in all frequencies used. 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.

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]	Test System	Dipole Type / SN	Probe Type / SN	Calibrated Signal Type	DAE Unit / SN	Dielectric Constant [ε] Body tissue simulant	Conductivity σ [S/m] Body tissue simulant	Validation Done
								Body tissue simulant
835	Verkotan SAR-2	D835V2 - SN: 448	EX3DV4 - SN: 3892	CW	DAE 4 / 756	53.0	0.97	05/2017

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 #
08.11.2017	B835	20.3	835	250mW	2.48	9.55	9.92	3.9	1

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 (%)
08.11.2017	B835	22	835	0.98	55.2	1.05	56.0	8.5	1.4
			902.75	1.05	55	1.09	55.7	3.9	1.2
			914.75	1.06	55	1.10	55.6	3.8	1.1
			927.25	1.06	55	1.11	55.6	3.9	1.1

5. TEST PROCEDURE

As a result of manufactures KDB inquiry, the test position was chosen to be the front surface of the device toward the phantom. Pictures of the test positions are in appendix A.

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

5.1.1 *Body-worn Configuration*, 20 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.

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 different 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, 20 mm separation distance

Band	Channel	Test Position*	Maximun Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Dudy Cycle	Measured SAR_{1g} [mW/g]	Scaling Factor	Reported SAR_{1g} [mW/g]	Plot #
UHF	25	Front surface	30.0	27.47	0.65*	1:1	0.438	2.08	0.91	
UHF	0	Front surface	30.0	27.3	0.5*	1:1	0.502	2.09	1.05	2
UHF	50	Front surface	30.0	27.01	0.73*	1:1	0.357	2.36	0.84	

*Drift considered in the scaling factor

*The picture of the test position is presented in appendix A.

APPENDIX A: PHOTOS OF THE DUT

RFID reader. The front surface was used for SAR testing. The RFID antenna is behind the front cover.

The front surface of the RFID reader.

RFID reader in test position with front surface towards the phantom with 20mm separation distance.

APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 8.11.2017 14:24:40

Test Laboratory: Verkotan Oy

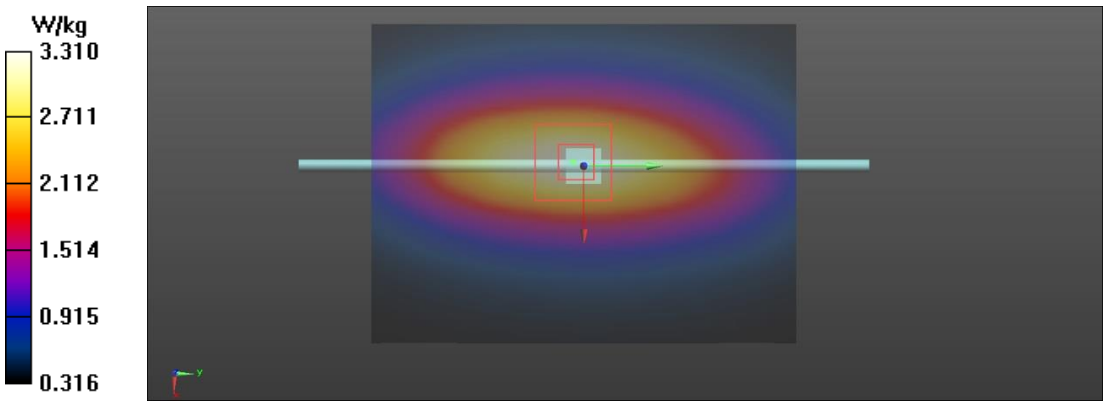
DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 – SN455

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 = 1.052 S/m; ε_r = 55.96; ρ = 1000 kg/m^3
Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(10.13, 10.13, 10.13); Calibrated: 18.4.2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 31.0
- Electronics: DAE4 Sn756; Calibrated: 24.1.2017
- Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA; Serial: 29-March-2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/d=15mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0
Reference Value = 57.06 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.86 W/kg
SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.66 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 3.31 W/kg
Configuration/d=15mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm Maximum value of SAR (interpolated) = 3.26 W/kg



APPENDIX C: MEASUREMENT SCAN

Plot 2 Date/Time: 8.11.2017 16:19:54

Test Laboratory: Verkotan Oy

DUT: EXA51; Type: RFID; Serial: K174000227

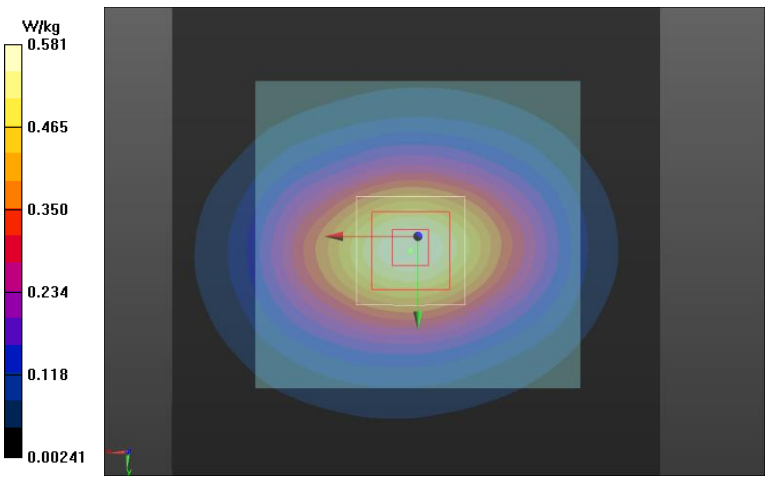
Communication System: UID 0, CW (0); Communication System Band: RFID; Frequency: 902.75 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 902.75 MHz; σ = 1.092 S/m; ε_r = 55.674; ρ = 1000 kg/m^3
Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(10.13, 10.13, 10.13); Calibrated: 18.4.2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
- Electronics: DAE4 Sn756; Calibrated: 24.1.2017
- Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA; Serial: 29-March-2017
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

Configuration/RFID 20mm 2 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 23.34 V/m; Power Drift = -0.50 dB Peak SAR (extrapolated) = 0.702 W/kg
SAR(1 g) = 0.502 W/kg; SAR(10 g) = 0.350 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.551 W/kg

Configuration/RFID 20mm 2 2/Area Scan (91x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.581 W/kg



APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS

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

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

Accreditation No.: SCS 0108

Multilateral Agreement for the recognition of calibration certificates

Client Verkotan Certificate No: EX3-3892_Apr17

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3892
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	April 18, 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	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
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:	Michael Weber	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 18, 2017

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

Certificate No: EX3-3892_Apr17 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]	0.48	0.38	0.47	± 10.1 %
DCP (mV)[B]	100.1	101.8	101.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	139.9	±3.0 %
		Y	0.0	0.0	1.0		141.1	
		Z	0.0	0.0	1.0		144.8	

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 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 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	10.28	10.28	10.28	0.49	0.94	± 12.0 %
900	41.5	0.97	9.74	9.74	9.74	0.45	0.94	± 12.0 %
1750	40.1	1.37	8.63	8.63	8.63	0.33	0.80	± 12.0 %
1900	40.0	1.40	8.26	8.26	8.26	0.38	0.80	± 12.0 %
2450	39.2	1.80	7.42	7.42	7.42	0.39	0.80	± 12.0 %
2600	39.0	1.96	7.30	7.30	7.30	0.42	0.80	± 12.0 %

[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.

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	10.11	10.11	10.11	0.47	0.80	± 12.0 %
900	55.0	1.05	10.13	10.13	10.13	0.53	0.80	± 12.0 %
1750	53.4	1.49	8.22	8.22	8.22	0.42	0.80	± 12.0 %
1900	53.3	1.52	7.92	7.92	7.92	0.27	1.03	± 12.0 %
2450	52.7	1.95	7.59	7.59	7.59	0.28	0.95	± 12.0 %

[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.

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[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

mvg Microwave Vision Group

SAR Reference Dipole Calibration Report

Ref : ACR.165.29.17.SATU.A

VERKOTAN LTD.
ELEKTRONIIKKATIE 17
90590, OULU, FINLAND
SAR REFERENCE DIPOLE
FREQUENCY: 835 MHZ
SERIAL NO.: D835V2-455

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

ilac-MRA A2LA ACCREDITED Calibration CERT #2240.02

Calibration Date: 06/14/17

Summary:

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

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	6/14/2017	
Checked by :	Jérôme LUC	Product Manager	6/14/2017	
Approved by :	Kim RUTKOWSKI	Quality Manager	6/14/2017	

	Customer Name
Distribution :	Verkotan Ltd.

Issue	Date	Modifications
A	6/14/2017	Initial release

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

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

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

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 40.0 sigma : 0.90
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56	9.46 (0.95)	6.22	6.08 (0.61)
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	

3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 57.5 sigma : 0.96
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8mm/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
835	9.84 (0.98)	6.45 (0.65)