

## SAR Compliance Test Report

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<b>Tested device:</b>	SU-18		
<b>FCC ID:</b>	LJPSU-18	<b>IC:</b>	661E-SU18
<b>Supplement reports:</b>	-		
<b>Testing has been carried out in accordance with:</b>	<p><b>47CFR §2.1093</b> Radiofrequency Radiation Exposure Evaluation: Portable Devices</p> <p><b>FCC OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01)</b> Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields</p> <p><b>RSS-102</b> Evaluation Procedure for Mobile and Portable Radio Transmitters with Respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields</p> <p><b>IEEE 1528 - 2003</b> IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques</p>		
<b>Documentation:</b>	The documentation of the testing performed on the tested devices is archived for 15 years at TCC Nokia.		
<b>Test results:</b>	The tested device complies with the requirements in respect of all parameters subject to the test. The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.		
<b>Date and signatures:</b>	2005-08-15		
<b>For the contents:</b>	 Janne Hirsimaki Test Engineer		

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## 1. SUMMARY OF SAR TEST REPORT

### 1.1 Test Details

Period of test	2005-07-25 to 2005-08-03
SN, HW and SW numbers of tested device	SN: 0631265, HW: 1601, SW: SU-18R-0.2005.27-2-TA-MRO, DUT: 30394
Batteries used in testing	BP-5L, DUT: 30397, 30398
Headsets used in testing	Philips SBC HP200
Other accessories used in testing	MU-unit: RS DV MMC 64MB
State of sample	Prototype unit
Notes	-

### 1.2 Maximum Results

The maximum measured SAR values for Body Worn configuration are given in section 1.2.1. The device conforms to the requirements of the standard(s) when the maximum measured SAR value is less than or equal to the limit.

#### 1.2.1 Head Configuration

The device does not have an internal earpiece for use against the ear. Therefore, no Head SAR testing has been carried out.

#### 1.2.2 Body Worn Configuration

Mode	Ch / f (MHz)	Radiated power	Separation distance	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
WLAN2450	6 / 2437.0	23.6 dBm EIRP	0.95cm	1.6 W/kg	0.58W/kg	PASSED

#### 1.2.3 Maximum Drift

Maximum drift during measurements	-0.09 dB
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#### 1.2.4 Measurement Uncertainty

Extended Uncertainty (k=2) 95%	± 29.8 %
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## 2. DESCRIPTION OF THE DEVICE UNDER TEST

Device category	Portable	
Exposure environment	General population / uncontrolled	

Modes and Bands of Operation	BT	WLAN
Modulation Mode	GFSK	
Duty Cycle		1
Transmitter Frequency Range (MHz)	2402-2480	2412-2462

### 2.1 Picture of the Device



### 2.2 Description of the Antenna

The device has an internal patch antenna.

## 3. TEST CONDITIONS

### 3.1 Temperature and Humidity

Ambient temperature (°C):	22.5 to 23.5
Ambient humidity (RH %):	45 to 61

### 3.2 Test Signal, Frequencies and Output Power

The device was put into operation by using command instructions.

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The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.

In all operating bands the measurements were performed on lowest, middle and highest channels.

The radiated output power of the device was measured by a separate test laboratory on the same unit as used for SAR testing.

## 4. DESCRIPTION OF THE TEST EQUIPMENT

### 4.1 Measurement System and Components

The measurements were performed using an automated near-field scanning system, DASY4 software version 4.5, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements on the device was the 'worst-case extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Serial Number	Calibration interval	Calibration expiry
DAE4	555	12 months	2006-02
E-field Probe ET3DV6	1765	12 months	2006-02
Dipole Validation Kit, D2450V2	729	24 months	2007-02

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	HP E4433B	GB39340614	24 months	2005-11
Amplifier	Amplifier Research 5S1G4	306024	-	-
Power Meter	R&S NRT	101143	12 months	2006-02
Power Sensor	R&S NRT-Z43	100239	12 months	2006-02
Thermometer	Fluke 51 II	84350048	12 months	2006-02
Thermometer	Fluke 52 II	82810048	12 months	2006-02
Network Analyzer	HP 8753D	3410A08934	12 months	2006-02
Dielectric Probe Kit	Agilent 85070D	US01440162	-	-

#### 4.1.1 Isotropic E-field Probe SN:1765

<b>Construction</b>	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., butyl diglycol)
<b>Calibration</b>	Calibration certificate in Appendix C
<b>Frequency</b>	10 MHz to 3 GHz (dosimetry); Linearity: $\pm 0.2$ dB (30 MHz to 3 GHz)
<b>Optical Surface</b>	$\pm 0.2$ mm repeatability in air and clear liquids over diffuse reflecting surfaces
<b>Detection</b>	$\pm 0.2$ dB in HSL (rotation around probe axis)
<b>Directivity</b>	$\pm 0.4$ dB in HSL (rotation normal to probe axis)
<b>Dynamic Range</b>	5 $\mu$ W/g to > 100 mW/g; Linearity: $\pm 0.2$ dB
<b>Dimensions</b>	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm
<b>Application</b>	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms

## 4.2 Phantoms

The phantom used for all tests i.e. for both system checking and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 - 2003.

System checking was performed using the flat section. Body SAR testing also used the flat section between the head profiles.

The SPEAG device holder (see Section 5.1) was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

## 4.3 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528 - 2003 and FCC Supplement C to OET Bulletin 65. All tests were carried out using simulants whose dielectric parameters were within  $\pm 5\%$  of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.

The depth of the tissue simulant was  $15.0 \pm 0.5$  cm measured from the ear reference point during system checking and device measurements.

### 4.3.1 Tissue Simulant Recipes

The following recipes were used for Head and Body tissue simulants:

2450MHz band	
Ingredient	Body (% by weight)
Deionised Water	70.2
Tween 20	29.62
Salt	0.18

### 4.3.2 System Checking

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyser. A system check measurement was made following the determination of the dielectric parameters of the simulant, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system checking results (dielectric parameters and SAR values) are given in the table below.

**System checking, body tissue simulant**

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			$\epsilon_r$	$\sigma$ [S/m]	
2450	Reference result	13.4	52.3	2.01	
	$\pm 10\%$ window	12.1 – 14.7			
	2005-07-25	13.3	51.4	1.95	22.0
	2005-08-03	13.5	51.5	1.95	21.8

Plots of the system checking scans are given in Appendix A.

**4.3.3 Tissue Simulants used in the Measurements**

**Body tissue simulant measurements**

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		$\epsilon_r$	$\sigma$ [S/m]	
2437	Recommended value	52.7	1.94	
	$\pm 5\%$ window	50.1 – 55.3	1.85 – 2.04	
	2005-07-25	51.5	1.93	22.1
	2005-08-03	51.5	1.92	21.8

**5. DESCRIPTION OF THE TEST PROCEDURE**

**5.1 Device Holder**

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



Device holder supplied by SPEAG

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A Nokia designed spacer (illustrated below) was used to position the device within the SPEAG holder. The spacer positions the device so that the holder has minimal effect on the test results but still holds the device securely. The spacer was removed before the tests.



Nokia spacer

## 5.2 Test Positions

### 5.2.1 Against Phantom Head

The device is not used against head.

### 5.2.2 Body Worn Configuration

The device was placed in the SPEAG holder using the Nokia spacer and placed below the flat section of the phantom. The distance between the device and the phantom was kept at the separation distance indicated in the photo below using a separate flat spacer that was removed before the start of the measurements. The device was oriented with its antenna facing the phantom and without cover since this configuration gives higher results.

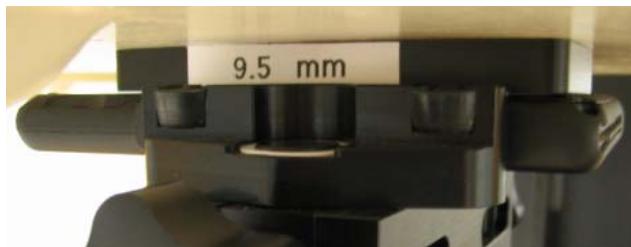


Photo of the device positioned for Body SAR measurement.

The spacer was removed for the tests.

## 5.3 Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan, a minimum of 5x5x7 points covering a volume of at least 30x30x30mm, was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

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## 5.4 SAR Averaging Methods

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

The interpolation, extrapolation and maximum search routines within Dasy4 are all based on the modified Quadratic Shepard's method (Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).

The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighbouring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

## 6. MEASUREMENT UNCERTAINTY

Table 6.1 – Measurement uncertainty evaluation

Uncertainty Component	Section in IEEE 1528	Tol. (%)	Prob Dist	Div	$c_i$	$c_i \cdot u_i$ (%)	$v_i$
<b>Measurement System</b>							
Probe Calibration	E2.1	$\pm 5.8$	N	1	1	$\pm 5.8$	$\infty$
Axial Isotropy	E2.2	$\pm 4.7$	R	$\sqrt{3}$	$(1-c_p)^{1/2}$	$\pm 1.9$	$\infty$
Hemispherical Isotropy	E2.2	$\pm 9.6$	R	$\sqrt{3}$	$(c_p)^{1/2}$	$\pm 3.9$	$\infty$
Boundary Effect	E2.3	$\pm 8.3$	R	$\sqrt{3}$	1	$\pm 4.8$	$\infty$
Linearity	E2.4	$\pm 4.7$	R	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
System Detection Limits	E2.5	$\pm 1.0$	R	$\sqrt{3}$	1	$\pm 0.6$	$\infty$
Readout Electronics	E2.6	$\pm 1.0$	N	1	1	$\pm 1.0$	$\infty$
Response Time	E2.7	$\pm 0.8$	R	$\sqrt{3}$	1	$\pm 0.5$	$\infty$
Integration Time	E2.8	$\pm 2.6$	R	$\sqrt{3}$	1	$\pm 1.5$	$\infty$
RF Ambient Conditions - Noise	E6.1	$\pm 3.0$	R	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
RF Ambient Conditions - Reflections	E6.1	$\pm 3.0$	R	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
Probe Positioner Mechanical Tolerance	E6.2	$\pm 0.4$	R	$\sqrt{3}$	1	$\pm 0.2$	$\infty$
Probe Positioning with respect to Phantom Shell	E6.3	$\pm 2.9$	R	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	$\pm 3.9$	R	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
<b>Test sample Related</b>							
Test Sample Positioning	E4.2.1	$\pm 6.0$	N	1	1	$\pm 6.0$	11
Device Holder Uncertainty	E4.1.1	$\pm 5.0$	N	1	1	$\pm 5.0$	7
Output Power Variation - SAR drift measurement	6.6.3	$\pm 10.0$	R	$\sqrt{3}$	1	$\pm 5.8$	$\infty$
<b>Phantom and Tissue Parameters</b>							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	$\pm 4.0$	R	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
Conductivity Target - tolerance	E3.2	$\pm 5.0$	R	$\sqrt{3}$	0.64	$\pm 1.8$	$\infty$
Conductivity - measurement uncertainty	E3.3	$\pm 5.5$	N	1	0.64	$\pm 3.5$	5
Permittivity Target - tolerance	E3.2	$\pm 5.0$	R	$\sqrt{3}$	0.6	$\pm 1.7$	$\infty$
Permittivity - measurement uncertainty	E3.3	$\pm 2.9$	N	1	0.6	$\pm 1.7$	5
<b>Combined Standard Uncertainty</b>			RSS			<b><math>\pm 14.9</math></b>	206
<b>Coverage Factor for 95%</b>			<b>k=2</b>				
<b>Expanded Standard Uncertainty</b>						<b><math>\pm 29.8</math></b>	

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## 7. RESULTS

The measured Body SAR values for the test device are tabulated below:

**2450MHz, Body SAR results**

Pen option	MU option	Test configuration	SAR, averaged over 1g (W/kg)		
			Ch 1 2412.0MHz	Ch 6 2437.0MHz	Ch 11 2462.0MHz
WLAN2450		Power	<b>19.1 dBm</b>	<b>23.6 dBm</b>	<b>20.9 dBm</b>
With pen	With MU	Without headset	0.179	0.504	0.281
		Headset Philips SBC HP200	0.156	<b>0.578</b>	0.222
No pen	With MU	Headset Philips SBC HP200	-	0.426	-
No pen	No MU	Headset Philips SBC HP200	-	0.507	-
With pen	No MU	Headset Philips SBC HP200	-	0.516	-

Plots of the Measurement scans are given in Appendix B.

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## APPENDIX A: SYSTEM CHECKING SCANS

Date/Time: 25.07.2005 13:23:52

Test Laboratory: TCC Nokia, Oulu Laboratory

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:729, System Check**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.95$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(4.35, 4.35, 4.35); Calibrated: 24.02.2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn555; Calibrated: 21.02.2005
- Phantom: SAM 2; Type: SAM 4.0; Serial: 1272
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**d=10mm, Pin=250mW, t=21.8 C/Area Scan (61x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 14.9 mW/g

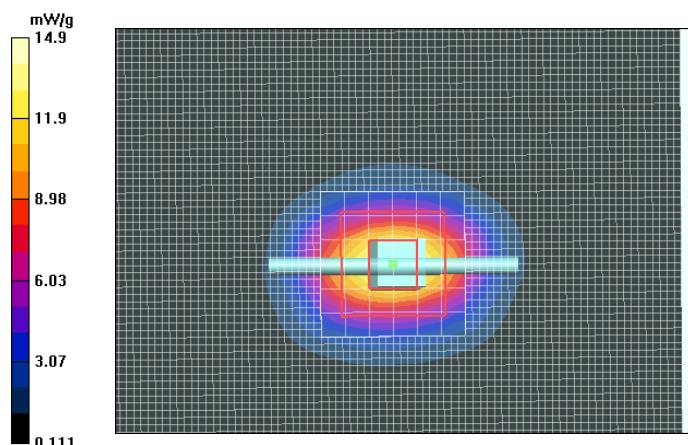
**d=10mm, Pin=250mW, t=21.8 C/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.3 V/m; Power Drift = -0.023 dB

Peak SAR (extrapolated) = 29.5 W/kg

**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.11 mW/g**

Maximum value of SAR (measured) = 14.9 mW/g



Date/Time: 03.08.2005 09:26:06

Test Laboratory: TCC Nokia, Oulu Laboratory

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:729, System Check**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.95$  mho/m;  $\epsilon_r = 51.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(4.35, 4.35, 4.35); Calibrated: 24.02.2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn555; Calibrated: 21.02.2005
- Phantom: SAM 2; Type: SAM 4.0; Serial: 1272
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

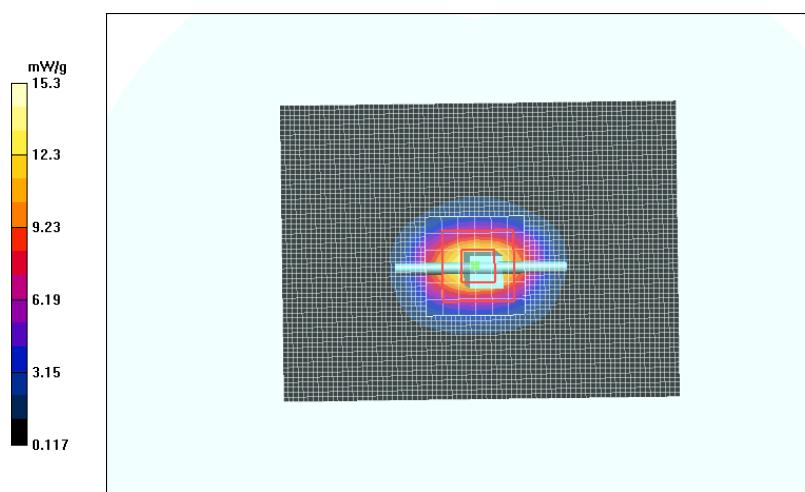
**d=10mm, Pin=250mW, t=21.8 C/Area Scan (61x81x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 15.4 mW/g

**d=10mm, Pin=250mW, t=21.8 C/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 93.5 V/m; Power Drift = -0.011 dB

Peak SAR (extrapolated) = 30.2 W/kg

**SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.23 mW/g**

Maximum value of SAR (measured) = 15.3 mW/g



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**APPENDIX B: MEASUREMENT SCANS**

Date/Time: 25.07.2005 16:48:16

Test Laboratory: TCC Nokia, Oulu Laboratory

**Type: SU-18, Body measurement, Worst Case Extrapolation, t=22.1 C,  
no cover, with headset, with pen, with MU**

Communication System: WLAN 2450; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.93$  mho/m;  $\epsilon_r = 51.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(4.35, 4.35, 4.35); Calibrated: 24.02.2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn555; Calibrated: 21.02.2005
- Phantom: SAM 2; Type: SAM 4.0; Serial: 1272
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**Body Measurement/Area Scan (61x91x1):** Measurement grid: dx=15mm, dy=15mm

**Info: Interpolated medium parameters used for SAR evaluation!**

Maximum value of SAR (interpolated) = 0.489 mW/g

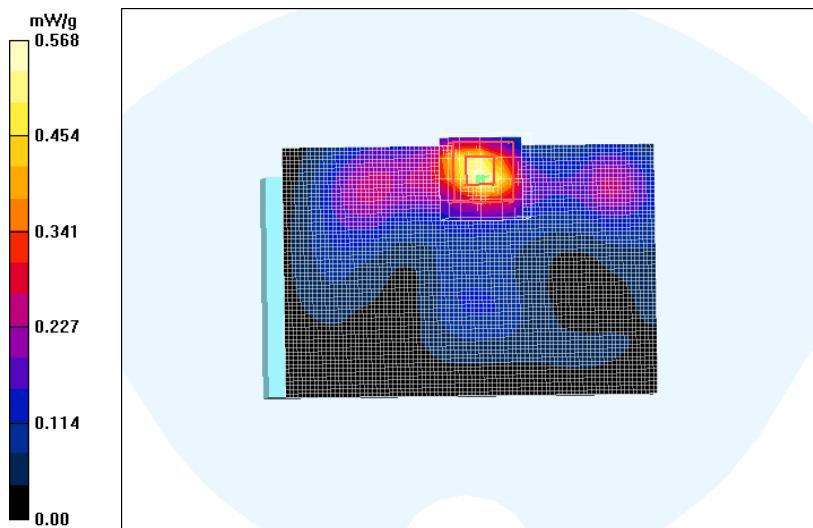
**Body Measurement/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

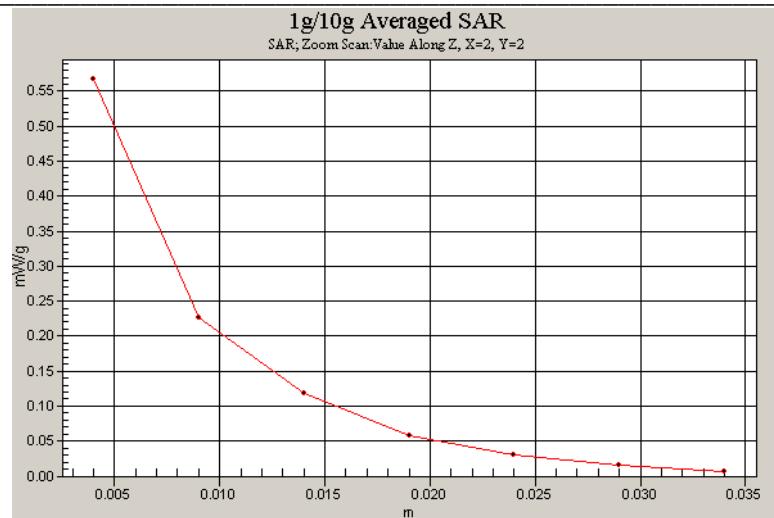
Reference Value = 8.19 V/m; Power Drift = -0.037 dB

Peak SAR (extrapolated) = 1.98 W/kg

**SAR(1 g) = 0.578 mW/g; SAR(10 g) = 0.241 mW/g**

Maximum value of SAR (measured) = 0.568 mW/g





Date/Time: 25.07.2005 14:41:50

Test Laboratory: TCC Nokia, Oulu Laboratory

**Type: SU-18, Body measurement, Worst Case Extrapolation, t=21.9 C, no cover, no headset, with pen, with MU**

Communication System: WLAN 2450; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2437 \text{ MHz}$ ;  $\sigma = 1.93 \text{ mho/m}$ ;  $\epsilon_r = 51.5$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(4.35, 4.35, 4.35); Calibrated: 24.02.2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn555; Calibrated: 21.02.2005
- Phantom: SAM 2; Type: SAM 4.0; Serial: 1272
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**Body Measurement/Area Scan (61x91x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

**Info: Interpolated medium parameters used for SAR evaluation!**

Maximum value of SAR (interpolated) = 0.456 mW/g

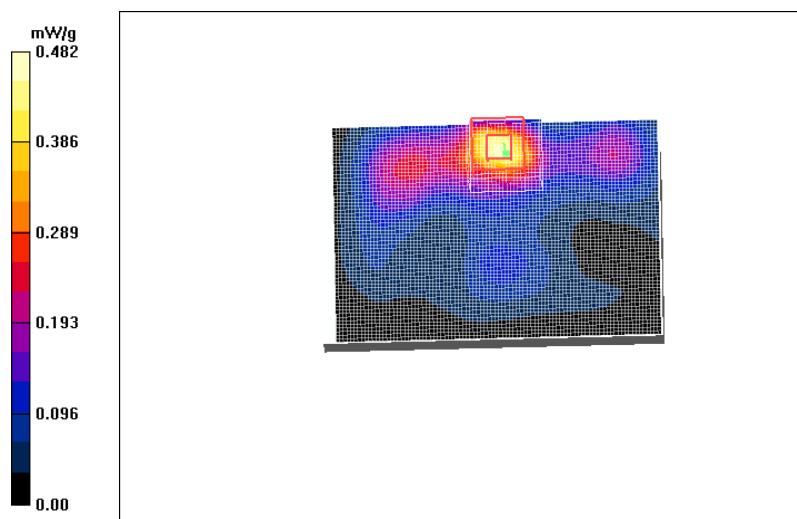
**Body Measurement/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=7.5\text{mm}$ ,  $dy=7.5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 7.67 V/m; Power Drift = -0.065 dB

Peak SAR (extrapolated) = 1.69 W/kg

**SAR(1 g) = 0.504 mW/g; SAR(10 g) = 0.217 mW/g**

Maximum value of SAR (measured) = 0.482 mW/g



Date/Time: 03.08.2005 10:04:54

Test Laboratory: TCC Nokia, Oulu Laboratory

**Type: SU-18, Body measurement, Worst Case Extrapolation, t=21.8 C,  
no cover, with headset, with pen, no MU**

Communication System: WLAN 2450; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.92$  mho/m;  $\epsilon_r = 51.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(4.35, 4.35, 4.35); Calibrated: 24.02.2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn555; Calibrated: 21.02.2005
- Phantom: SAM 2; Type: SAM 4.0; Serial: 1272
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**Body Measurement/Area Scan (61x91x1):** Measurement grid: dx=15mm, dy=15mm

**Info: Interpolated medium parameters used for SAR evaluation!**

Maximum value of SAR (interpolated) = 0.421 mW/g

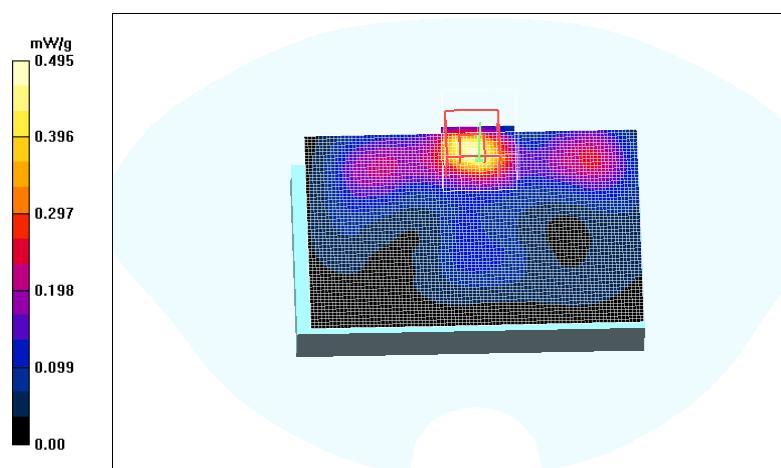
**Body Measurement/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 8.19 V/m; Power Drift = -0.061 dB

Peak SAR (extrapolated) = 1.73 W/kg

**SAR(1 g) = 0.516 mW/g; SAR(10 g) = 0.216 mW/g**

Maximum value of SAR (measured) = 0.495 mW/g



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**APPENDIX C: RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)**

E-field probe, SN: 1765  
See the next three pages



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 The Swiss Accreditation Service is one of the signatories to the EA  
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Nokia Oulu**

Certificate No: **ET3-1765\_Feb05**

## CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1765**

Calibration procedure(s) **QA CAL-01.v5**  
 Calibration procedure for dosimetric E-field probes

Calibration date: **February 24, 2005**

Condition of the calibrated item **In Tolerance**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-04 (METAS, No. 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No. 251-00388)	May-05
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-04 (METAS, No. 251-00389)	May-05
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-04 (METAS, No. 251-00404)	Aug-05
Reference Probe ES3DV2	SN: 3013	7-Jan-05 (SPEAG, No. ES3-3013_Jan05)	Jan-06
DAE4	SN: 617	19-Jan-05 (SPEAG, No. DAE4-617_Jan05)	Jan-06
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

Calibrated by:	Name	Function	Signature
	Nico Vetterli	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 25, 2005

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

## DASY - Parameters of Probe: ET3DV6 SN:1765

Sensitivity in Free Space <sup>A</sup>			Diode Compression <sup>B</sup>	
NormX	<b>1.61</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	93 mV
NormY	<b>1.86</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	93 mV
NormZ	<b>1.94</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	93 mV

### Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

### Boundary Effect

TSL                    900 MHz                    Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>be</sub> [%]      Without Correction Algorithm	8.7	4.4
SAR <sub>be</sub> [%]      With Correction Algorithm	0.6	0.1

TSL                    1750 MHz                    Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>be</sub> [%]      Without Correction Algorithm	13.1	8.4
SAR <sub>be</sub> [%]      With Correction Algorithm	0.6	0.1

### Sensor Offset

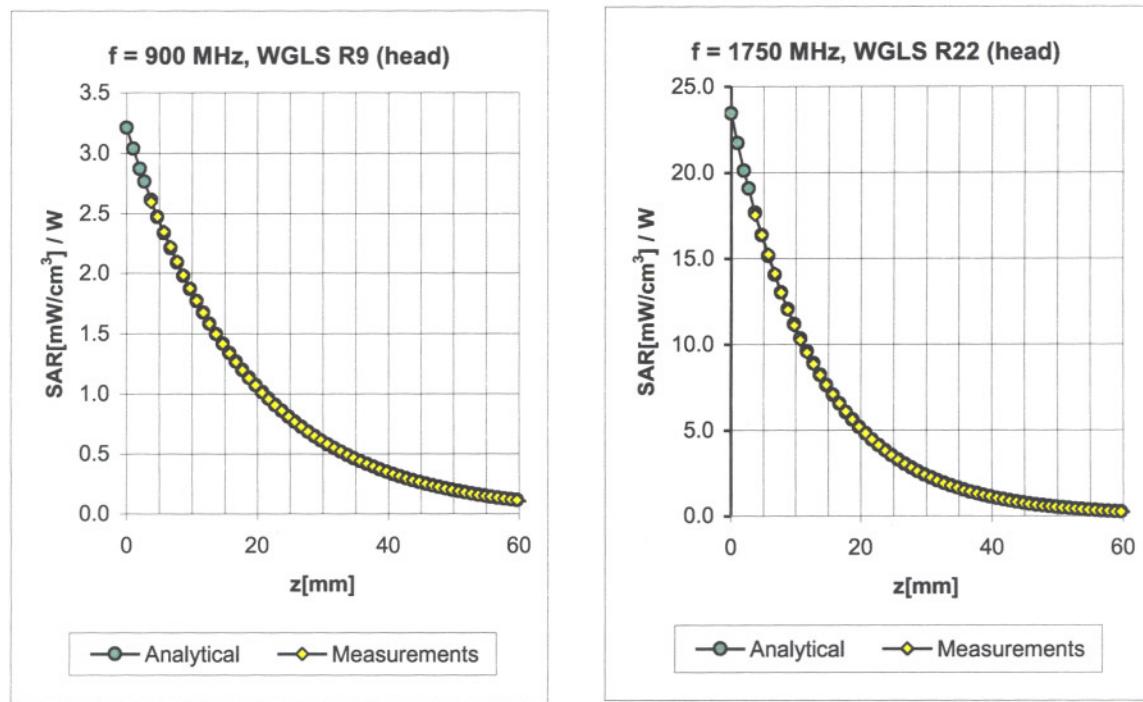
Probe Tip to Sensor Center                    **2.7** mm

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%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

## Conversion Factor Assessment



$f$ [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
835	$\pm 50 / \pm 100$	Head	$41.5 \pm 5\%$	$0.90 \pm 5\%$	1.22	1.42	$6.72 \pm 11.0\%$ (k=2)	
900	$\pm 50 / \pm 100$	Head	$41.5 \pm 5\%$	$0.97 \pm 5\%$	1.28	1.37	$6.43 \pm 11.0\%$ (k=2)	
1750	$\pm 50 / \pm 100$	Head	$40.1 \pm 5\%$	$1.37 \pm 5\%$	0.68	2.14	$5.21 \pm 11.0\%$ (k=2)	
1900	$\pm 50 / \pm 100$	Head	$40.0 \pm 5\%$	$1.40 \pm 5\%$	0.65	2.30	$5.13 \pm 11.0\%$ (k=2)	
1950	$\pm 50 / \pm 100$	Head	$40.0 \pm 5\%$	$1.40 \pm 5\%$	0.60	2.48	$4.89 \pm 11.0\%$ (k=2)	
2450	$\pm 50 / \pm 100$	Head	$39.2 \pm 5\%$	$1.80 \pm 5\%$	0.72	2.21	$4.55 \pm 11.8\%$ (k=2)	
835	$\pm 50 / \pm 100$	Body	$55.2 \pm 5\%$	$0.97 \pm 5\%$	1.24	1.45	$6.32 \pm 11.0\%$ (k=2)	
900	$\pm 50 / \pm 100$	Body	$55.0 \pm 5\%$	$1.05 \pm 5\%$	1.17	1.50	$6.00 \pm 11.0\%$ (k=2)	
1750	$\pm 50 / \pm 100$	Body	$53.4 \pm 5\%$	$1.49 \pm 5\%$	0.60	2.64	$4.75 \pm 11.0\%$ (k=2)	
1900	$\pm 50 / \pm 100$	Body	$53.3 \pm 5\%$	$1.52 \pm 5\%$	0.60	2.71	$4.67 \pm 11.0\%$ (k=2)	
1950	$\pm 50 / \pm 100$	Body	$53.3 \pm 5\%$	$1.52 \pm 5\%$	0.66	2.42	$4.50 \pm 11.0\%$ (k=2)	
2450	$\pm 50 / \pm 100$	Body	$52.7 \pm 5\%$	$1.95 \pm 5\%$	0.78	1.95	$4.35 \pm 11.8\%$ (k=2)	

<sup>c</sup> The validity of  $\pm 100$  MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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**APPENDIX D: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORT(S)**

Dipole 2450MHz, SN: 729  
See the next three pages



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The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Nokia Oulu 2

Certificate No: D2450V2-729\_Feb05

## CALIBRATION CERTIFICATE

Object D2450V2 - SN: 729

Calibration procedure(s) QA CAL-05.v6  
Calibration procedure for dipole validation kits

Calibration date: February 10, 2005

Condition of the calibrated item In Tolerance

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference Probe ES3DV2	SN 3025	29-Oct-04 (SPEAG, No. ES3-3025_Oct04)	Oct-05
DAE4	SN 601	07-Jan-05 (SPEAG, No. DAE4-601_Jan05)	Jan-06
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-03)	In house check: Oct-05
RF generator R&S SML-03	100698	27-Mar-02 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05

Calibrated by:	Name	Function	Signature
	Mike Meili	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 11, 2005

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

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN729**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U10 BB;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.78$  mho/m;  $\epsilon_r = 39.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

**DASY4 Configuration:**

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom 5.0; Type: QD000P50AA; Serial: 1001;
- Measurement SW: DASY4, V4.5 Build 11; Postprocessing SW: SEMCAD, V1.8 Build 142

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 16.7 mW/g

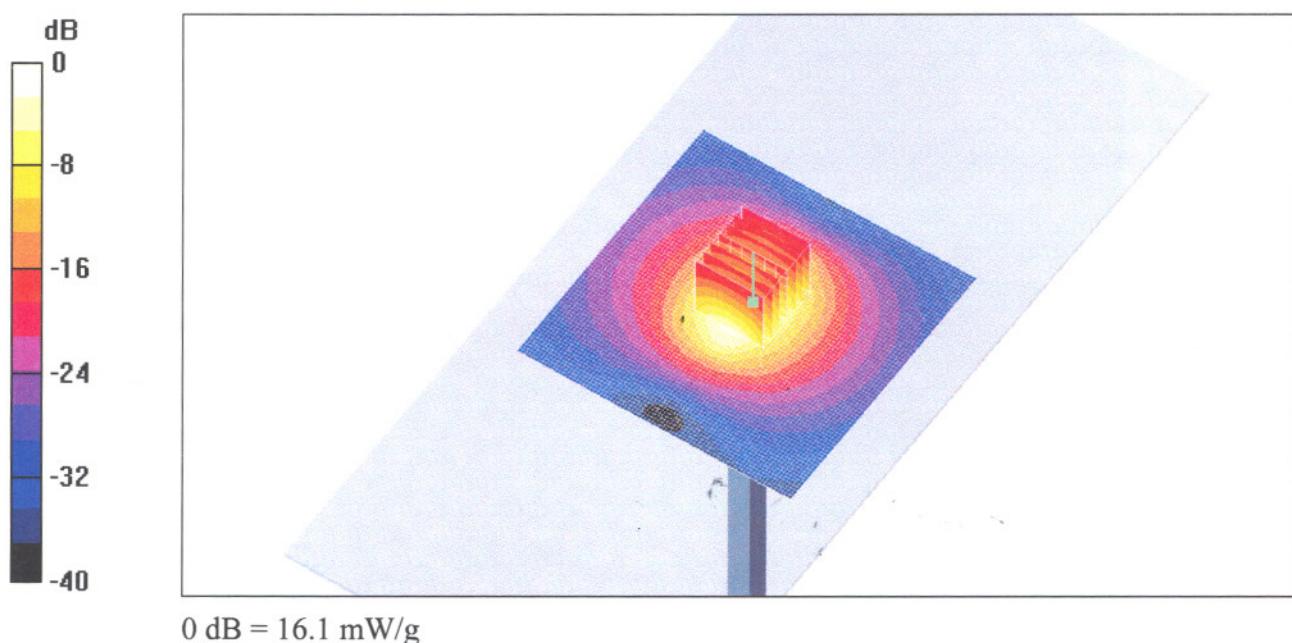
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.1 V/m; Power Drift = 0.0 dB

Peak SAR (extrapolated) = 28.9 W/kg

**SAR(1 g) = 14.2 mW/g; SAR(10 g) = 6.6 mW/g**

Maximum value of SAR (measured) = 16.1 mW/g



Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN729**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: M2450;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 52.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

**DASY4 Configuration:**

- Probe: ES3DV2 - SN3025; ConvF(4.13, 4.13, 4.13); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom 5.0; Type: QD000P50AA; Serial: 1001;
- Measurement SW: DASY4, V4.5 Build 11; Postprocessing SW: SEMCAD, V1.8 Build 142

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 15.7 mW/g

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 86.7 V/m; Power Drift = 0.0 dB

Peak SAR (extrapolated) = 27.3 W/kg

**SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.19 mW/g**

Maximum value of SAR (measured) = 15.2 mW/g

