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**TEST REPORT**

**REFERENCE STANDARDS:**

**FCC 47CFR Part 2.1093 (10-1-09 Edition)**

**FCC OET Bulletin 65, Supplement C (Edition 01-01)**

**IC RSS-102 Issue 4 (2010-03)**

<b>NIE</b> ..... :	32605RET.002
Approved by (name / position & signature) .....	A. Llamas / RF Lab Manager .....
Elaboration date .....	2011-02-04
<b>Identification of item tested</b> .....	Intel® Centrino® Wireless-N 1000 inside a host device
Trademark .....	Intel
Model and/or type reference .....	USA: 112BNHMW / Canada: 112BNHU
Serial number .....	MAC: 001E6400E962
Other identification of the product .....	FCC ID: PD9112BNHU / IC: 1000M-112BNHU
Features .....	802.11 b/g/n
Description .....	Wireless Module: Intel® Centrino® Wireless-N 1000 Antenna Type: Yageo 25.90A1E.011 and 25.90A1F.011 Host platform: Lenovo TP00019A PC
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<b>Test samples supplier</b> .....	Same as applicant
<b>Manufacturer</b> .....	Same as applicant

<b>Test method requested</b> .....	See Standard
<b>Standard</b> .....	<ol style="list-style-type: none"> <li>1. FCC 47 CFR Part 2.1093 (10-1-09 Edition). Radiofrequency radiation exposure evaluation: portable devices.</li> <li>2. FCC OET Bulletin 65, Supplement C (Edition 01-01), “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”.</li> <li>3. IC RSS-102 Issue 4 (2010-03). Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)</li> </ol>
<b>Application Notes</b> .....	<ol style="list-style-type: none"> <li>1. FCC OET KDB 248227 – SAR Measurements Procedures 802.11a/b/g Transmitters (May 2007 – Revised).</li> <li>2. FCC OET KDB 447498 – Mobile and Portable Device, RF Exposure Procedures and Equipment Authorization Policies (November 2009).</li> <li>3. FCC OET KDB 450824 – SAR Probe Calibration and System Verification Considerations for measurements at 150 MHz – 3 GHz (January 2007).</li> <li>4. FCC OET KDB 865664 – SAR Measurements Requirements for 3-6 GHz (October 2006).</li> <li>5. IC RSS-102 Supplementary Procedures (SPR)-001 (2011-01). SAR testing requirements with regard to bystanders for laptop type computers with antennas built-in on display screen (laptop mode/tablet mode).</li> </ol>
<b>Test procedure</b> .....	PERF062
<b>Non-standardized test method</b> .....	N/A
<b>Used instrumentation</b> .....	<ol style="list-style-type: none"> <li>1. Dosimetric E-field probe SPEAG ES3DV3</li> <li>2. Data acquisition device SPEAG DAE4</li> <li>3. Electro-optical converter SPEAG EOC3</li> <li>4. 2450 MHz dipole validation kit SPEAG D2450V2</li> <li>5. Robot STÄUBLI RX60BL</li> <li>6. Robot controller STÄUBLI CM7MB</li> <li>7. Oval flat phantom SPEAG ELI 4</li> <li>8. SAR measurement software SPEAG DASY4 V4.7 Build 80</li> <li>9. Measurement server SPEAG DASY4 SE UMS 001 DC</li> <li>10. Body Tissue Equivalent Liquids for 2450MHz band</li> <li>11. Vector network analyzer Agilent E5071C</li> <li>12. Dielectric probe kit Agilent 85070C</li> <li>13. Power meter R&amp;S NRVD</li> <li>14. Power Sensor R&amp;S NRV-Z51</li> <li>15. Power Sensor R&amp;S NRV-Z1</li> <li>16. RF Generator Agilent ESG E4438C</li> <li>17. Dual directional coupler NARDA FSCM 99899</li> <li>18. Power amplifier MITEQ AMF-4D-00400600-50-30P</li> <li>19. Laptop positioning extension SPEAG Laptop Holder</li> </ol>
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### **Competences and guarantees**

AT4 wireless is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 342.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance programme for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

### **General conditions**

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

### **Uncertainty**

Uncertainty (factor  $k=2$ ) was calculated according to the following documents:

1. FCC OET Bulletin 65, Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".
2. FCC OET KDB 865664 – SAR Measurements Requirements for 3-6 GHz (October 2006).

### Usage of samples

Samples undergoing test have been selected by: **the client**.

Sample M/01 is composed of the following elements:

<u>Control N°</u>	<u>Description</u>	<u>Model</u>	<u>Serial N°</u>	<u>Date of reception</u>
32605/07	WiFi module inside a host device	Intel® Centrino® Wireless- N 1000 / Lenovo TP00019A PC / Yageo Antennas	MAC: 001E6400E962	2010-12-27

1. Sample M/01 has undergone the test(s) specified in subclause “Test method requested”.

### Testing period

The performed test started on 2010-01-24 and finished on the same day.

The tests have been performed at AT4 wireless.

### Environmental conditions

In the laboratory for measurements, the following limits were not exceeded during the test:

Temperature	Min. = 20.02 °C Max. = 23.92 °C
Relative humidity	Min. = 35.71 % Max. = 41.95 %

**Summary**

Considering the results of the performed test according to FCC 47CFR Part 2.1093, the item under test is **IN COMPLIANCE** with the requested specifications specified in the standard.

The maximum 1g volume averaged SAR found during this test has been 0.313 W/kg, for the 2450 MHz band and 802.11b with 20 MHz bandwidth mode.

NOTE: The results presented in this Test Report apply only to the particular item under test established in page 1 of this document, as presented for test on the date(s) shown in section, "USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS".

**Remarks and comments**

- 1: 802.11n = 20MHz BW / 802.11n\* = 40MHz BW.
- 2: Testing of 802.11g is not required due to the testing reductions mentioned in FCC OET KDB 248227 – SAR Measurements Procedures 802.11a/b/g Transmitters (May 2007 – Revised), paragraph "Frequency Channel Configurations".
- 3: Testing of other channels in each band is optional when the maximum output channel SAR fulfills the testing reductions mentioned in FCC OET KDB 248227 – SAR Measurements Procedures 802.11a/b/g Transmitters (May 2007 – Revised), paragraph "Frequency Channel Configurations".
- 4: All the test positions of device relative to body were measured placing the device in direct contact with the phantom surface, so the requirements mentioned at RSS-102 Supplementary Procedures (SPR)-001 - SAR TESTING REQUIREMENTS WITH REGARD TO BYSTANDERS FOR LAPTOP TYPE COMPUTERS WITH ANTENNAS BUILT-IN ON DISPLAY SCREEN (LAPTOP MODE/TABLET MODE) are covered.

**Testing verdicts**

Not applicable .....: NA  
 Pass.....: P  
 Fail .....: F  
 Not measured.....: NM

**2450 MHz band**

FCC 47CFR Part 2.1093 Paragraph	VERDICT			
	NA	P	F	NM
(d)(2) 802.11b		P		
(d)(2) 802.11g				NM <sup>2</sup>
(d)(2) 802.11n <sup>1</sup>		P		
(d)(2) 802.11n* <sup>1</sup>		P		

1 and 2: See Remarks and Comments.

## **APPENDIX A: Test Configuration**

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## **1. GENERAL INTRODUCTION**

### **1.1. Application Standard**

The Federal Communications Commission (FCC) sets the limits for General Population / Uncontrolled exposure to radio frequency electromagnetic fields for transmitting devices designed to be used within 20 centimetres of the user body under FCC 47 CFR Part 2.1093 - "Radiofrequency radiation exposure evaluation: portable devices", paragraph (d)(2).

Specific requirements and procedure for SAR assessment are describe under FCC OET Bulletin 65, Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields", and all the FCC OET Knowledge Database documents referred at the beginning of this document.

### **1.2. General requirements**

The SAR measurement has been performed continuing the following considerations and environment conditions:

- The ambient temperature shall be in the range of 18°C to 25°C and the variation shall not exceed +/-2°C during the test.
- The ambient humidity shall be in the range of and 30% - 70%.
- The device battery shall be fully charged before each measurement.

### **1.3. Measurement system and phantom requirements**

The measurement system used for SAR tests fulfils the procedural and technical requirements described at the reference standards used.

The phantom is a simplified representation of the human anatomy and comprised of material with electrical properties similar to the corresponding tissues in human body.

### **1.4. Measurement Liquids requirements.**

The liquids used to simulate the human tissues, must fulfils the requirements of the dielectric properties required. These target dielectric properties per FCC OET KDB 450824 instructions come from the dipole and probe calibration data which are included in Appendix B, Section 2, of this document.

As indicated in FCC OET KDB 450824, it is allowed a 5% variation of the above mentioned level at the 2450 MHz band.

## 2. MEASUREMENT SYSTEM

### 2.1. Measurement System

Manufacturer	Device	Type
Schmid & Partner Engineering AG	Dosimetric E-Fiel Probe	ES3DV3
Schmid & Partner Engineering AG	Data Acquisition Electronics	DAE4
Schmid & Partner Engineering AG	Electro-Optical Converter	EOC5
Schmid & Partner Engineering AG	2450 MHz System Validation Dipole	D2450V2
Stäubli	Robot	RX60BL
Stäubli	Robot controller	CM7MB
Schmid & Partner Engineering AG	Oval flat phantom	ELI 4
Schmid & Partner Engineering AG	Measurement Software	DASY V4.7 Build 80
Schmid & Partner Engineering AG	Measurement Server	DASY4 SE UMS 001 DC
Agilent	Vector Network Analyser	E5071C
Agilent	Dielectric Probe Kit	85070C
Rohde & Schwarz	Power Meter	NRVD
Rohde & Schwarz	Power Sensor	NRV-Z51
Rohde & Schwarz	Power Sensor	NRV-Z1
Agilent	RF Generator	ESG E4438C
NARDA	Dual directional coupler	FSCM 99899
MITEQ	Power amplifier	AMF-4D-00400600-50-30P
Schmid & Partner Engineering AG	Laptop Holder	SM LH1 001 AC

**Table 1:** Measurement Equipment

## **2.2. Test Positions of device relative to body <sup>4</sup>**

The laptop device was tested in three different positions, as stated at FCC OET KDB 447498 – Mobile and Portable Device, RF Exposure Procedures and Equipment Authorization Policies (November 2009) paragraph 4) b):

- Lapheld: with the base in direct contact with the phantom, with the display folded on top of the keyboard section.
- Secondary Portrait: edge with the most conservative exposure condition for the main antenna at portrait configuration.
- Secondary Landscape: edge with the most conservative exposure condition for the main antenna at landscape configuration.

Further analysis was performed to determine the location which showed the highest SAR.

## **2.3. Test to be performed**

In all operating modes and bands the measurements have to be performed on the “default test channels” defined at FCC OET KDB 248227 – SAR Measurements Procedures 802.11a/b/g Transmitters (May 2007 – Revised), except those channels defined as “required test channels” at the same document.

## **2.4. Description of interpolation/extrapolation scheme**

The local SAR inside the Phantom is measured using small dipole sensing elements inside a probe element. The probe tip must not be in contact with the Phantom’s surface in order to minimise measurement errors, but the highest local SAR is obtained from measurements at a certain distances from the shell trough extrapolation. The accurate assessment of the maximum SAR averaged over 1 gr. and 10 gr. requires a very fine resolution in the three dimensional scanned data array. Since the measurements have to be performed over a limited time, the measured data have to be interpolated to provide an array of sufficient resolution.

The interpolation of 2D area scan is used after the initial area scan, at a fixed distance from the Phantom shell wall. The initial scan data is collected with a proper spatial resolution and this interpolation is used to find the location of the local maximum for positioning the subsequent 3D scanning to within a 1mm resolution.

For the 3D scan, data is collected on a spatially regular 3D grid having 5mm steps in both lateral directions, and 5mm in depth direction for the 2450MHz band. After the data collection by the SAR probe, the data are extrapolated in the depth direction to assign values to points in the 3D array closer to the shell wall. A notional extrapolation value is also assigned to the first point outside the shell wall so that subsequent interpolation schemes will be applicable right up to the shell wall boundary.

## **2.5. Determination of the largest peak spatial-average SAR**

To determine the maximum value of the peak spatial-average SAR of a EUT, all device positions, configurations and operational modes should be tested for each frequency band.

According to FCC 47 CFR Part 2.1093, the averaging volume shall be chosen as 1 g of contiguous tissue. The cubic volumes, over which the SAR measurements are averaged after extrapolation and interpolation, are chosen in order to include the highest values of local SAR.

The maximum SAR level for the EUT will be the maximum level obtained of the performed measurements, and indicated in the previous points.

## **2.6. System Validation**

Prior to the SAR measurements, system verification is done daily to verify the system accuracy. As FCC OET Bulletin 65 – Supplement C, Appendix D “SAR measurement procedures” Paragraph “System Verification” specifies, a complete SAR evaluation is done using a half-wavelength dipole as source with the frequency of the mid-band channel of the operating band, or within 100MHz of this channel.

The measured 1 gr. and 10 gr. SAR should be within 10% of the expected target values specified in the calibration certificate of the dipole, for the specific tissue and frequency used.

### 3. UNCERTAINTY

#### Uncertainty for 300 MHz – 6 GHz

ERROR SOURCES	Uncertainty value (%)	Probability distribution	Divisor	(c <sub>i</sub> ) 1g	(c <sub>i</sub> ) 10g	Standard uncertainty (1g) (%)	Standard uncertainty (10g) (%)	v <sub>i</sub> v <sub>eff</sub>
<b>Measurement Equipment</b>								
Probe Calibration	±4.480	Normal	1	1	1	±4.480	±4.480	∞
Axial Isotropy	±7.558	Rectangular	√3	1	1	±4.364	±4.364	∞
Hemispherical Isotropy	±2.000	Rectangular	√3	1	1	±1.155	±1.155	∞
Boundary effect	±4.700	Rectangular	√3	1	1	±2.714	±2.714	∞
Linearity	±1.000	Rectangular	√3	1	1	±0.577	±0.577	∞
System detection limits	±0.300	Rectangular	√3	1	1	±0.300	±0.300	∞
Readout electronics	±1.010	Normal	1	1	1	±0.583	±0.583	∞
Response time	±2.600	Rectangular	√3	1	1	±1.501	±1.501	∞
Integration time	±3.000	Rectangular	√3	1	1	±1.732	±1.732	∞
RF Ambien conditions	±3.000	Rectangular	√3	1	1	±1.732	±1.732	∞
Probe positioner	±0.800	Rectangular	√3	1	1	±0.462	±0.462	∞
Probe positioning	±9.900	Rectangular	√3	1	1	±5.716	±5.716	∞
Maximum SAR evaluation	±1.000	Rectangular	√3	1	1	±0.577	±0.577	∞
<b>Test Sample Related</b>								
Device positioning	±2.900	Normal	1	1	1	±2.900	±2.900	145
Device Holder	±3.600	Normal	1	1	1	±3.600	±3.600	5
Power Drift	±5.000	Rectangular	√3	1	1	±2.887	±2.887	∞
<b>Phantom and Setup</b>								
Phantom uncertainty	±4.000	Rectangular	√3	1	1	±2.309	±2.309	∞
Liquid conductivity (deviation from target)	±5.000	Rectangular	√3	0.64	0.43	±1.848	±1.241	∞
Liquid conductivity (measurement error)	±3.100	Normal	1	0.64	0.43	±1.984	±1.333	∞
Liquid permittivity (deviation from target)	±5.000	Rectangular	√3	0.64	0.43	±1.848	±1.241	∞
Liquid permittivity (measurement error)	±4.410	Normal	1	0.64	0.43	±2.822	±1.896	∞
<b>Combined standard uncertainty</b>	$u_c = \sqrt{\sum_{i=1}^m c_i^2 \cdot u_i^2}$					±11.99	±11.56	330
<b>Expanded uncertainty (confidence interval of 95%)</b>	$ue = 2.00 u_c$					±23.98	±23.11	

**Table 2:** Uncertainty Assessment for 300 MHz - 6 GHz

#### 4. SAR LIMIT

Having a worst case measurement, the SAR limit is valid for general population/uncontrolled exposure.

The SAR values have to be averaged over a mass of 1g (SAR<sub>1 gr.</sub>) with the shape of a cube. This level couldn't exceed the values indicated in the application Standard:

Standard	SAR	SAR Limit (W/Kg)
FCC 47 CFR Part 2.1093 Paragraph (d)(2)	SAR <sub>1 gr.</sub>	1.6

**Table 3:** SAR limit

## **APPENDIX B: Test results**

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## 1. TEST CONDITIONS

### 1.1. Power supply (V):

$V_n = 11.1$  Vdc battery

Type of power supply = DC Voltage from rechargeable Li-Ion 11.1 V battery.

### 1.2. Temperature (°C):

$T_n = +20.02$  to  $+23.92$

The subscript n indicates normal test conditions.

### 1.3. Test signal, Output Power and Frequencies

The device was put into operation by using an own control software to program the test mode required for select the continuous transmission with 100% duty cycle.

In all operating bands the measurements were performed on the “default test channels” defined at FCC OET KDB 248227 – SAR Measurements Procedures 802.11a/b/g Transmitters (May 2007 – Revised), except those that fulfil the frequency channel selection criteria mentioned on paragraph “Frequency Channel Configuration” at the same document.

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

The maximum average conducted power of the device was measured with a Power meter R&S NRVD and a thermocoupled Power sensor NRV-Z51.

### 1.4. DUT information

The device under test was the Intel® Centrino® Wireless-N 1000 card located inside a host device (Lenovo TP00019A PC) computer which utilises a set of Yageo antennas (25.90A1E.011 and 25.90A1F.011). The card was operated utilizing proprietary software (CRTU Version 5.20.1.0) and each channel was measured using a broadband power meter to determine the maximum average power.

The output power of Bluetooth device is 3.06mW ( $\leq 60/f(\text{GHz})$ ) and the antenna-to-antenna distance between the Bluetooth antenna and the WLAN main antenna is 10.9cm. Therefore, no SAR testing is required for the Bluetooth transmitter.

Collocation with WWAN transmitter has not been considered following grantee request because this collocation will be considered in the WWAN transmitter SAR testing.

## 2. TISSUE PARAMETERS MEASUREMENTS

Frequency (MHz)	Target Body Tissue: Parameters used in Probe Calibration		Target Body Tissue: Parameters used in Dipole Calibration		Measured Body Tissue		Measured Date
	Permittivity	Conductivity [S/m]	Permittivity	Conductivity [S/m]	Permittivity	Conductivity [S/m]	
2450	52.7 ± 5%	1.95 ± 5%	53.2 ± 6%	2.00 ± 6%	50.92	1.98	2011-01-24

Note: The dielectric properties have been measured by the contact probe method at 22° C.

## 3. SYSTEM VALIDATION MEASUREMENTS

### 3.1. Validation results in 2450 MHz Band for Body TSL

SAR	Target SAR (W/kg)	Measured SAR (W/kg)	Drift (%)	Limit (%)
1 gr.	53.90	51.57	-4.32	± 10
10 gr.	25.30	23.79	-5.99	± 10

## 4. CONDUCTED AVERAGE POWER MEASUREMENTS

Mode	Channel	Frequency (MHz)	Conducted Power (dBm)
802.11b	1	2412	16.59
	6	2437	16.61
	11	2462	16.50
802.11g	1	2412	12.27
	6	2437	16.41
	11	2462	11.4
802.11n <sup>1</sup>	1	2417	11.75
	6	2437	16.67
	11	2457	10.85
802.11n* <sup>1</sup>	3	2422	10.33
	6	2437	12.25
	9	2452	9.54

1: See Remarks and Comments.

## 5. MEASUREMENT RESULTS FOR SAR (SPECIFIC ABSORPTION RATE)

### 5.1. Summary maximum results

2450 MHz band:

Band	Mode	Channel	Frequency (MHz)	Measured SAR 1g (W/Kg)	SAR limit 1g (W/Kg)
2450 MHz band	802.11b	6	2437	0.313	1.6
	802.11g	-	-	NM <sup>2</sup>	1.6
	802.11n <sup>1</sup>	6	2437	0.309	1.6
	802.11n* <sup>1</sup>	6	2437	0.123	1.6

1 and 2: See Remarks and Comments.

### 5.2. Results for 2450 MHz Band – Lapheld Mode

Mode	Channel	Frequency (MHz)	SAR averaged over 1g (W/Kg)	Power Drift (%)	Limit (%)
802.11b	1	2412	NM <sup>3</sup>	-	±5
	6	2437	0.027	0.48	±5
	11	2462	NM <sup>3</sup>	-	±5
802.11g	1	2412	NM <sup>2</sup>	-	±5
	6	2437	NM <sup>2</sup>	-	±5
	11	2462	NM <sup>2</sup>	-	±5
802.11n <sup>1</sup>	1	2417	NM <sup>3</sup>	-	±5
	6	2437	0.028	1.12	±5
	11	2457	NM <sup>3</sup>	-	±5
802.11n* <sup>1</sup>	3	2422	NM <sup>3</sup>	-	±5
	6	2437	0.026	0.08	±5
	9	2452	NM <sup>3</sup>	-	±5

1, 2 and 3: See Remarks and Comments.

### 5.3. Results for 2450 MHz Band – Secondary Portrair Mode

Mode	Channel	Frequency (MHz)	SAR averaged over 1g (W/Kg)	Power Drift (%)	Limit (%)
802.11b	1	2412	NM <sup>3</sup>	-	±5
	6	2437	0.09	-0.59	±5
	11	2462	NM <sup>3</sup>	-	±5
802.11g	1	2412	NM <sup>2</sup>	-	±5
	6	2437	NM <sup>2</sup>	-	±5
	11	2462	NM <sup>2</sup>	-	±5
802.11n <sup>1</sup>	1	2417	NM <sup>3</sup>	-	±5
	6	2437	0.092	-0.131	±5
	11	2457	NM <sup>3</sup>	-	±5
802.11n* <sup>1</sup>	3	2422	NM <sup>3</sup>	-	±5
	6	2437	0.040	0.72	±5
	9	2452	NM <sup>3</sup>	-	±5

1, 2 and 3: See Remarks and Comments.

### 5.4. Results for 2450 MHz Band – Secondary Landscape Mode

Mode	Channel	Frequency (MHz)	SAR averaged over 1g (W/Kg)	Power Drift (%)	Limit (%)
802.11b	1	2412	NM <sup>3</sup>	-	±5
	6	2437	0.313	1.31	±5
	11	2462	NM <sup>3</sup>	-	±5
802.11g	1	2412	NM <sup>2</sup>	-	±5
	6	2437	NM <sup>2</sup>	-	±5
	11	2462	NM <sup>2</sup>	-	±5
802.11n <sup>1</sup>	1	2417	NM <sup>3</sup>	-	±5
	6	2437	0.309	-0.97	±5
	11	2457	NM <sup>3</sup>	-	±5
802.11n* <sup>1</sup>	3	2422	NM <sup>3</sup>	-	±5
	6	2437	0.123	-0.22	±5
	9	2452	NM <sup>3</sup>	-	±5

1, 2 and 3: See Remarks and Comments.

## **APPENDIX C: Measurements Reports**

**2450 MHz Band – Lapheld Mode – 802.11b Channel 6**

**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - LapHeld**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 25/10/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11b, Channel 6/Area Scan (51x101x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.027 mW/g

**Chain A, 802.11b, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

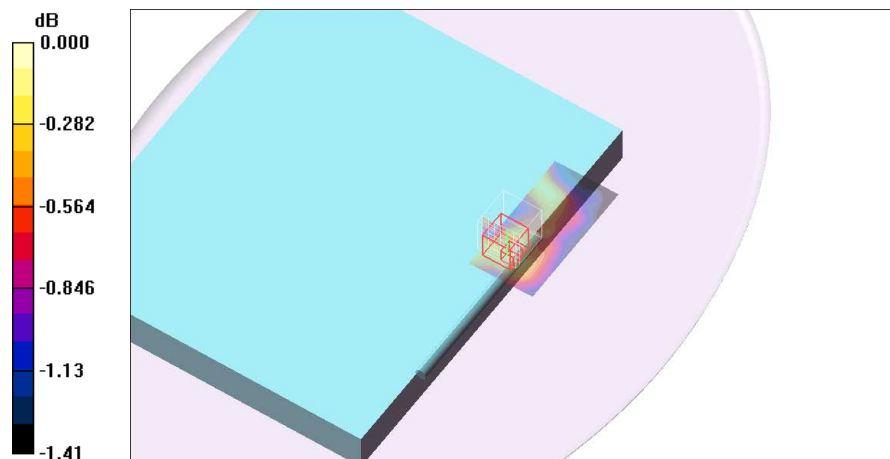
Reference Value = 3.67 V/m; Power Drift = 0.042 dB

Peak SAR (extrapolated) = 0.034 W/kg

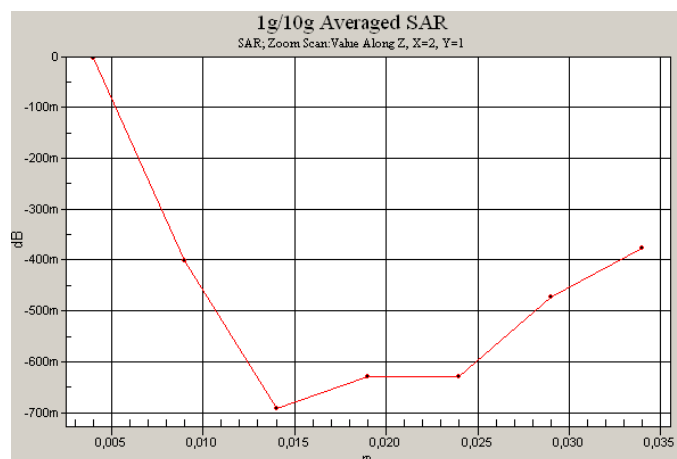
**SAR(1 g) = 0.027 mW/g; SAR(10 g) = 0.025 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.028 mW/g



0 dB = 0.028mW/g



**2450 MHz Band – Lapheld Mode – 802.11n Channel 6**

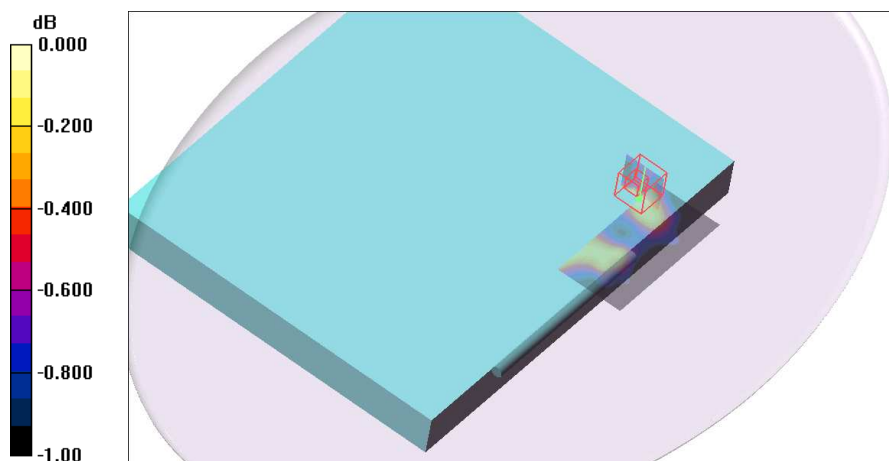
**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - LapHeld**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

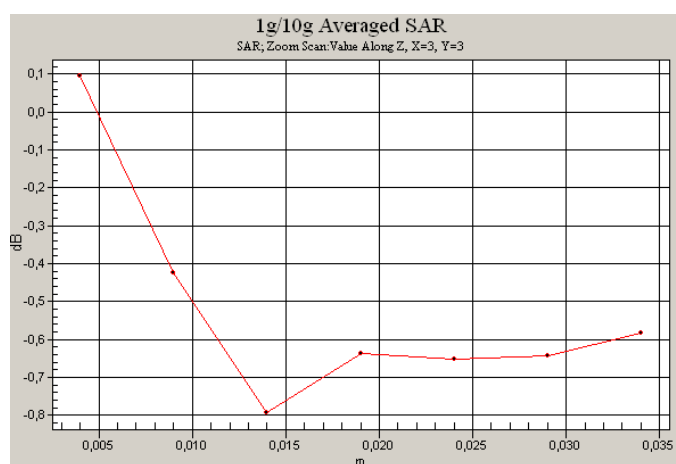
DASY4 Configuration:  
 - Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010  
 - Sensor-Surface: 4mm (Mechanical Surface Detection)  
 - Electronics: DAE4 Sn669; Calibrated: 25/10/2010  
 - Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060  
 - Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11n, Channel 6/Area Scan (51x101x1):** Measurement grid: dx=10mm, dy=10mm  
[Info: Interpolated medium parameters used for SAR evaluation.](#)  
 Maximum value of SAR (interpolated) = 0.027 mW/g

**Chain A, 802.11n, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 3.60 V/m; Power Drift = 0.097 dB  
 Peak SAR (extrapolated) = 0.039 W/kg  
**SAR(1 g) = 0.028 mW/g; SAR(10 g) = 0.025 mW/g**  
[Info: Interpolated medium parameters used for SAR evaluation.](#)  
 Maximum value of SAR (measured) = 0.031 mW/g



0 dB = 0.027mW/g



**2450 MHz Band – Lapheld Mode – 802.11n\* Channel 6**

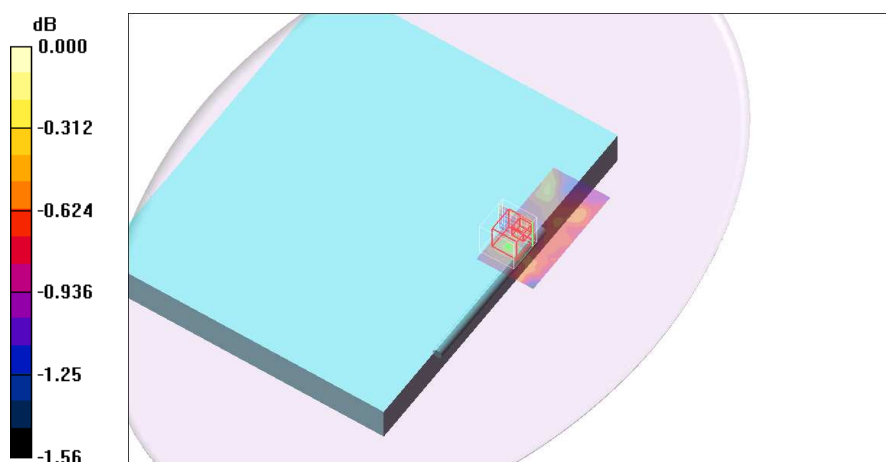
**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - LapHeld**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

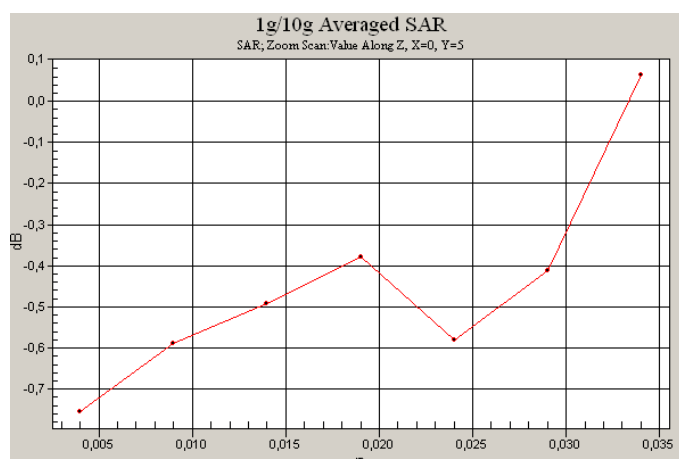
DASY4 Configuration:  
 - Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010  
 - Sensor-Surface: 4mm (Mechanical Surface Detection)  
 - Electronics: DAE4 Sn669; Calibrated: 25/10/2010  
 - Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060  
 - Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11n\*, Channel 6/Area Scan (51x101x1):** Measurement grid: dx=10mm, dy=10mm  
[Info: Interpolated medium parameters used for SAR evaluation.](#)  
 Maximum value of SAR (interpolated) = 0.025 mW/g

**Chain A, 802.11n\*, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 3.56 V/m; Power Drift = 0.007 dB  
 Peak SAR (extrapolated) = 0.028 W/kg  
**SAR(1 g) = 0.026 mW/g; SAR(10 g) = 0.025 mW/g**  
[Info: Interpolated medium parameters used for SAR evaluation.](#)  
 Maximum value of SAR (measured) = 0.028 mW/g



0 dB = 0.028mW/g





**2450 MHz Band – Secondary Portrait Mode – 802.11b Channel 6**

**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - Secondary Portrait**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 25/10/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11b, Channel 6/Area Scan (71x71x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.105 mW/g

**Chain A, 802.11b, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

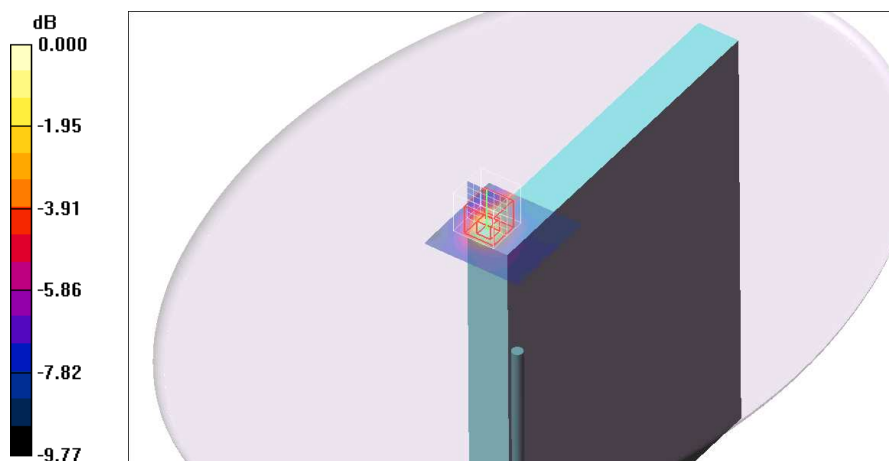
Reference Value = 5.95 V/m; Power Drift = -0.051 dB

Peak SAR (extrapolated) = 0.191 W/kg

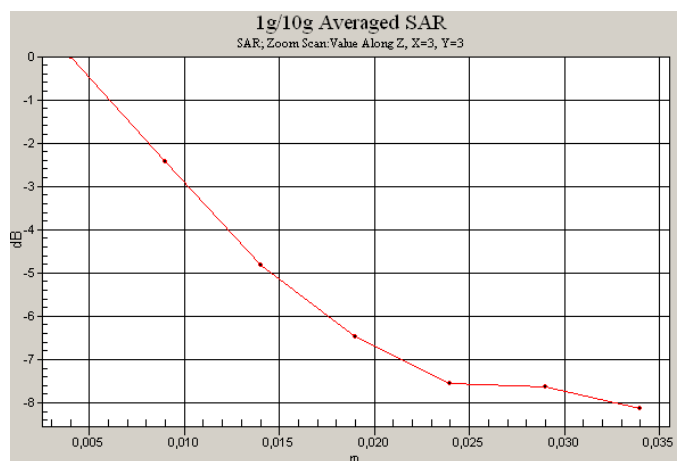
**SAR(1 g) = 0.090 mW/g; SAR(10 g) = 0.046 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.100 mW/g



0 dB = 0.100mW/g



**2450 MHz Band – Secondary Portrait Mode – 802.11n Channel 6**

**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - Secondary Portrait**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 25/10/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11n, Channel 6/Area Scan (71x71x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.109 mW/g

**Chain A, 802.11n, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

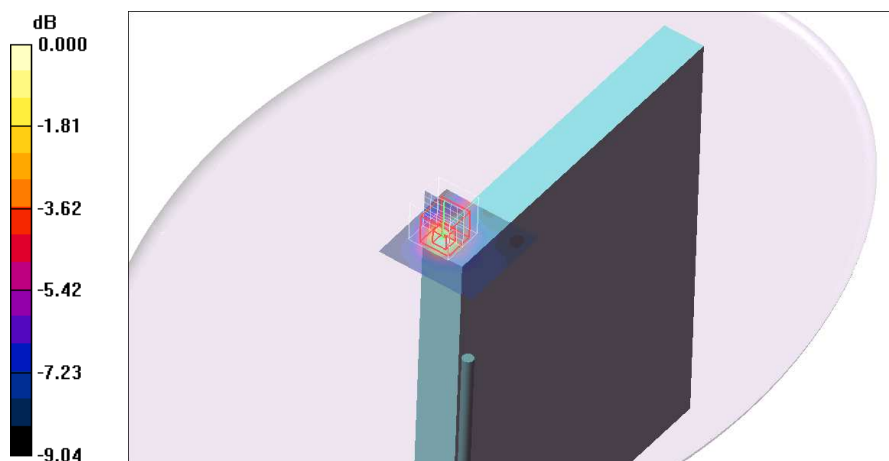
Reference Value = 6.18 V/m; Power Drift = -0.131 dB

Peak SAR (extrapolated) = 0.190 W/kg

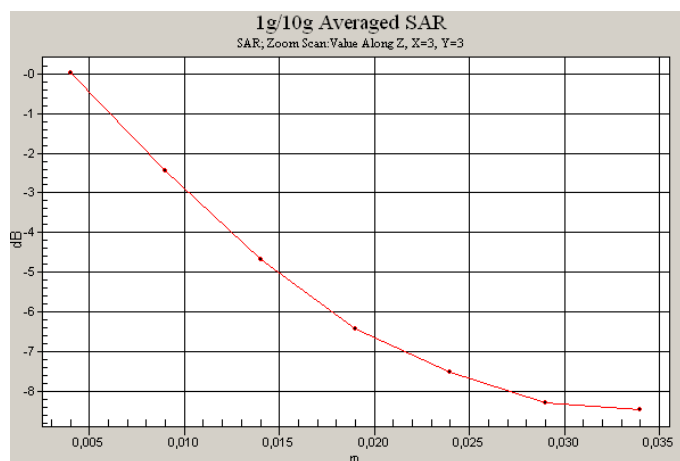
**SAR(1 g) = 0.092 mW/g; SAR(10 g) = 0.047 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.105 mW/g



0 dB = 0.105mW/g



**2450 MHz Band – Secondary Portrait Mode – 802.11n\* Channel 6**

**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - Secondary Portrait**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 25/10/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11n\*, Channel 6/Area Scan (71x71x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.045 mW/g

**Chain A, 802.11n\*, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

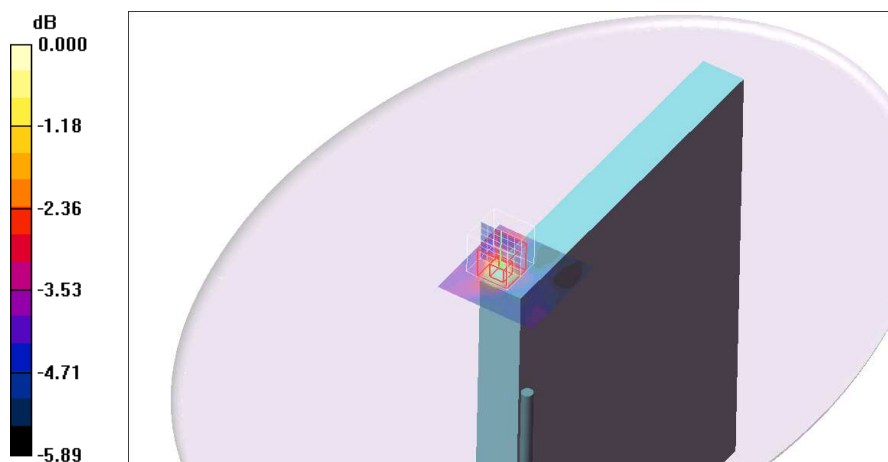
Reference Value = 4.73 V/m; Power Drift = 0.062 dB

Peak SAR (extrapolated) = 0.079 W/kg

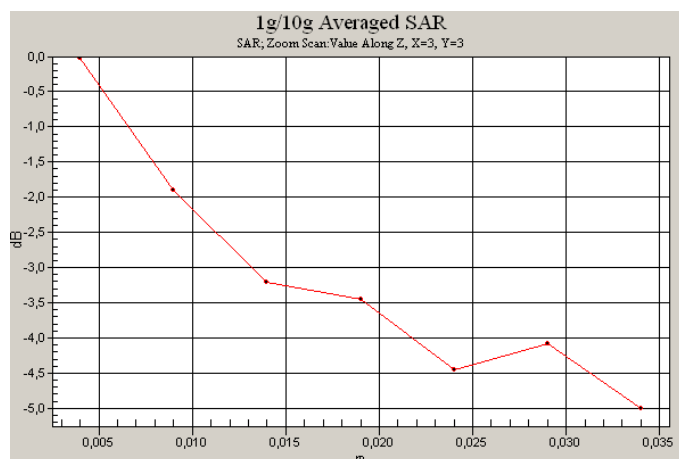
**SAR(1 g) = 0.040 mW/g; SAR(10 g) = 0.024 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.043 mW/g



0 dB = 0.043mW/g



## 2450 MHz Band – Secondary Landscape Mode – 802.11b Channel 6

**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - Secondary Landscape**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 50.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 25/10/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11b, Channel 6/Area Scan (51x151x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.409 mW/g

**Chain A, 802.11b, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

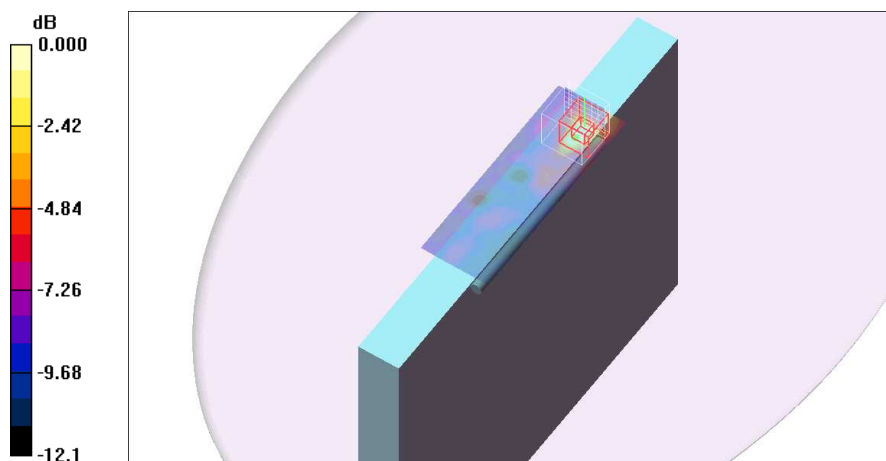
Reference Value = 10.3 V/m; Power Drift = 0.113 dB

Peak SAR (extrapolated) = 0.867 W/kg

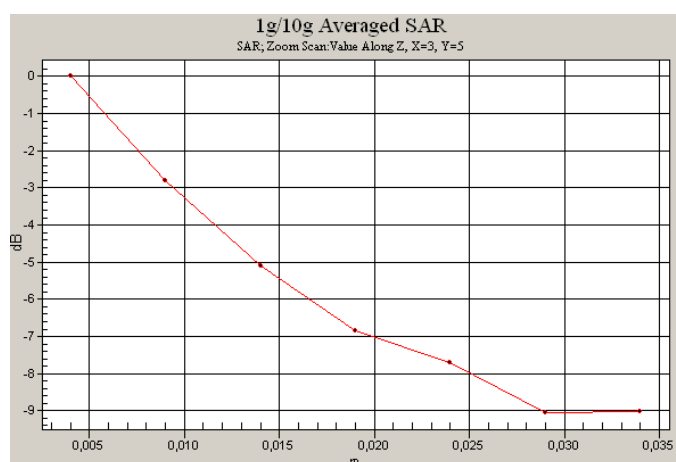
**SAR(1 g) = 0.313 mW/g; SAR(10 g) = 0.144 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.347 mW/g



0 dB = 0.347mW/g



## 2450 MHz Band – Secondary Landscape Mode – 802.11n Channel 6

**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - Secondary Landscape**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 50.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 25/10/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11n, Channel 6/Area Scan (51x151x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.397 mW/g

**Chain A, 802.11n, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

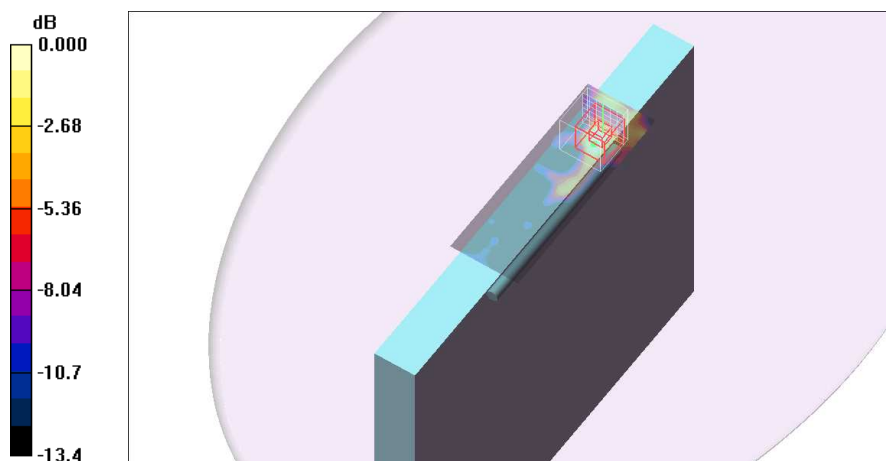
Reference Value = 13.0 V/m; Power Drift = -0.085 dB

Peak SAR (extrapolated) = 0.714 W/kg

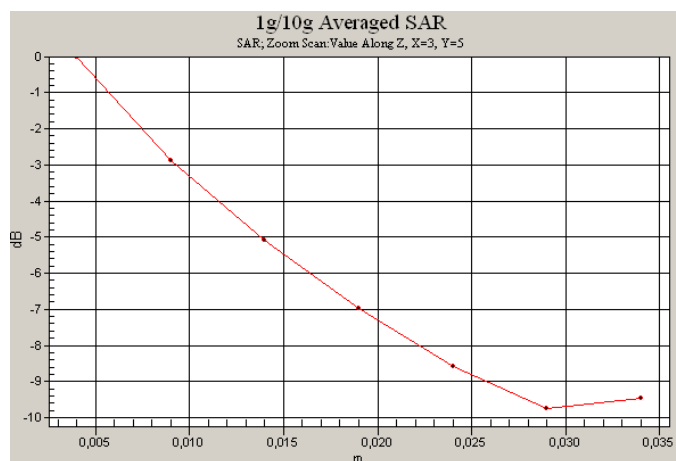
**SAR(1 g) = 0.309 mW/g; SAR(10 g) = 0.143 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.358 mW/g



0 dB = 0.358mW/g



**2450 MHz Band – Secondary Landscape Mode – 802.11n\* Channel 6**

**DUT: Lenovo TP00019A PC + Intel 112BNHMW + Yageo; Serial: R9-8VV2M 10/11**  
**Program Name: 802.11 at 2450MHz - Secondary Landscape**

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 50.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 25/10/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Chain A, 802.11n\*, Channel 6/Area Scan (51x151x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.390 mW/g

**Chain A, 802.11n\*, Channel 6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

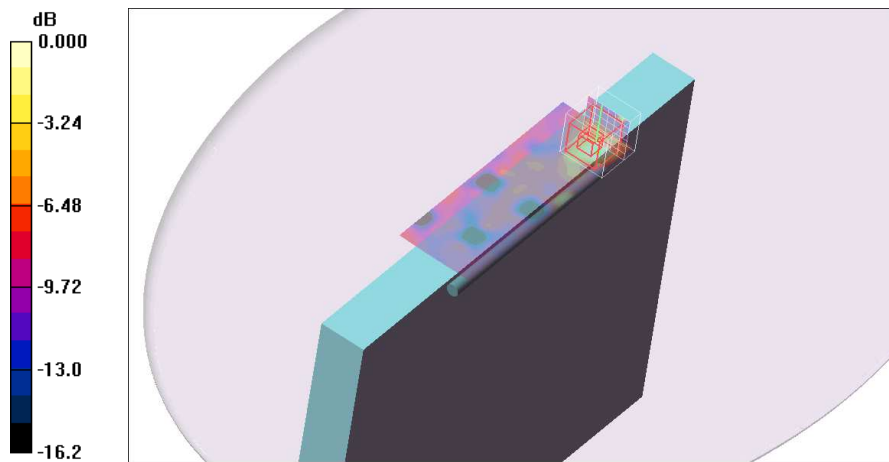
Reference Value = 6.20 V/m; Power Drift = -0.019 dB

Peak SAR (extrapolated) = 0.800 W/kg

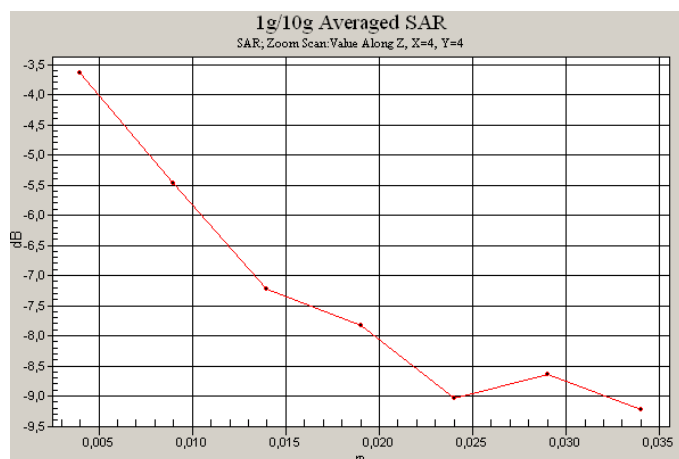
**SAR(1 g) = 0.123 mW/g; SAR(10 g) = 0.061 mW/g**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.691 mW/g



0 dB = 0.300mW/g



## **APPENDIX D: Calibration Data**

**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

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 108**

Client **AT4wireless**

Certificate No: **ES3-3052\_Oct10**

## CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN:3052**

Calibration procedure(s): **QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25 v2  
Calibration procedure for dosimetric E-field probes**

Calibration date: **October 22, 2010**



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 ( $22 \pm 3$ )°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	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 6648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: October 23, 2010

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



ES3DV3 SN:3052

October 22, 2010

### DASY/EASY - Parameters of Probe: ES3DV3 SN:3052

#### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	1.10	1.23	1.13	$\pm 10.1\%$
DCP (mV) <sup>B</sup>	97.9	96.1	97.0	

#### Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc <sup>E</sup> (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	300.0	$\pm 1.5\%$
			Y	0.00	0.00	1.00	300.0	
			Z	0.00	0.00	1.00	300.0	

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

<sup>A</sup> The uncertainties of NormX, Y, Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

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

<sup>E</sup> Uncertainty is determined using the maximum deviation from linear response applying recatangular distribution and is expressed for the square of the field value.

ES3DV3 SN:3052

October 22, 2010

## DASY/EASY - Parameters of Probe: ES3DV3 SN:3052

### Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz] <sup>c</sup>	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
750	± 50 / ± 100	43.5 ± 5%	0.87 ± 5%	6.25	6.25	6.25	0.88	1.02 ± 11.0%
835	± 50 / ± 100	41.5 ± 5%	0.90 ± 5%	5.97	5.97	5.97	0.66	1.15 ± 11.0%
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	5.82	5.82	5.82	0.55	1.32 ± 11.0%
1750	± 50 / ± 100	40.1 ± 5%	1.37 ± 5%	5.16	5.16	5.16	0.41	1.53 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	4.95	4.95	4.95	0.35	1.80 ± 11.0%
2000	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	4.85	4.85	4.85	0.36	1.70 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.33	4.33	4.33	0.32	2.21 ± 11.0%
2600	± 50 / ± 100	39.0 ± 5%	1.96 ± 5%	4.22	4.22	4.22	0.34	2.06 ± 11.0%

<sup>c</sup> The validity of ± 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.

ES3DV3 SN:3052

October 22, 2010

## DASY/EASY - Parameters of Probe: ES3DV3 SN:3052

### Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz] <sup>c</sup>	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
750	± 50 / ± 100	56.7 ± 5%	0.94 ± 5%	6.02	6.02	6.02	0.61	1.24 ± 11.0%
835	± 50 / ± 100	55.2 ± 5%	0.97 ± 5%	5.93	5.93	5.93	0.72	1.19 ± 11.0%
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	5.81	5.81	5.81	0.63	1.22 ± 11.0%
1750	± 50 / ± 100	53.4 ± 5%	1.49 ± 5%	4.70	4.70	4.70	0.32	2.19 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.51	4.51	4.51	0.34	2.26 ± 11.0%
2000	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.54	4.54	4.54	0.33	2.28 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.14	4.14	4.14	0.72	1.19 ± 11.0%
2600	± 50 / ± 100	52.5 ± 5%	2.16 ± 5%	4.01	4.01	4.01	0.99	0.99 ± 11.0%

<sup>c</sup> The validity of ± 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.

**Calibration Laboratory of  
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**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** 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 108**

Client: **AT4wireless**

Certificate No: **D2450V2-756\_Jun09**

## CALIBRATION CERTIFICATE

Object: **D2450V2 - SN: 756**

Calibration procedure(s): **QA CAL-05.v7  
Calibration procedure for dipole validation kits**

Calibration date: **June 19, 2009**

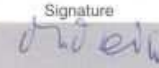

Condition of the calibrated item: **In Tolerance**

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-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047.2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probe ES3DV2	SN: 3025	28-Apr-08 (No. ES3-3025_Apr08)	Apr-09
Reference Probe ES3DV2	SN: 3025	30-Apr-09 (No. ES3-3025_Apr09)	Apr-10
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

Issued: June 19, 2009

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

### Measurement Conditions

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

DASY Version	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.4 $\pm$ 6 %	1.78 mho/m $\pm$ 6 %
Head TSL temperature during test	(22.4 $\pm$ 0.2) °C	----	----

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 mW / g
SAR normalized	normalized to 1W	53.2 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>53.9 mW /g <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.29 mW / g
SAR normalized	normalized to 1W	25.2 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>25.3 mW /g <math>\pm</math> 16.5 % (k=2)</b>

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	----	----

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.4 mW / g
SAR normalized	normalized to 1W	53.6 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>53.0 mW /g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.27 mW / g
SAR normalized	normalized to 1W	25.1 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>25.0 mW /g ± 16.5 % (k=2)</b>

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"