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Libro 82, Folio 133, Hoja MA3729

ENSAYOS Nº 51/LE342

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)

NIE ..... :	34184RRF.001
Approved by (name / position & signature) ..... :	A. Llamas / RF Lab. Manager
Elaboration date ..... :	2011-08-24

Alejandro Llamas Rodríguez
Firmado digitalmente por Alejandro Llamas Rodríguez
Fecha: 2011.08.24 11:40:26 +02'00'

Identification of item tested ..... :	Intel® Centrino® Wireless-N 1030 inside a host laptop
Trademark ..... :	Intel
Model and/or type reference ..... :	USA: 11230BNHMW / Canada: 11230BNHU
Serial number ..... :	MAC: BC7737794FD7
Other identification of the product ..... :	FCC ID: PD911230BNHU / IC: 1000M-11230BNHU
Features ..... :	802.11 b/g/n
Description ..... :	Wireles Module: Intel® Centrino® Wireless-N 1030 Antenna Type: Yageo 25.90A72.011 / 25.90A71.011 Host platform: Lenovo U400
Applicant ..... :	Intel Corporation
Address ..... :	100 Center Point Circle, Suite 200, Columbia, SC 29210, USA
CIF/NIF/Passport ..... :	---
Contact person:	Steven C. Hackett (Wireless Regulatory Engineer)
Telephone / Fax ..... :	803-216-2344
e-mail: ..... :	steven.c.hackett@intel.com
Test samples supplier ..... :	Same as applicant
Manufacturer ..... :	Same as applicant

Test method requested .....:	See Standard
Standard .....:	1. FCC 47 CFR Part 2.1093 (10-1-09 Edition). Radiofrequency radiation exposure evaluation: portable devices. 2. FCC OET Bulletin 65, Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields". 3. IC RSS-102 Issue 4 (2010-03). Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
Application Notes .....:	1. FCC OET KDB 248227 – SAR Measurements Procedures 802.11a/b/g Transmitters (May 2007 – Revised). 2. FCC OET KDB 616217 D03 – SAR Evaluation Considerations for Notebook/Netbook and Laptop Computers (November 2009). 3. FCC OET KDB 450824 – SAR Probe Calibration and System Verification Considerations for measurements at 150 MHz – 3 GHz (January 2007). 4. 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).
Test procedure .....:	PERF019
Non-standardized test method .....:	N/A
Used instrumentation .....:	1. Dosimetric E-field probe SPEAG ES3DV3 2. Data acquisition device SPEAG DAE4 3. Electro-optical converter SPEAG EOC3 4. 2450 MHz dipole validation kit SPEAG D2450V2 5. Robot STÄUBLI RX60BL 6. Robot controller STÄUBLI CM7MB 7. Oval flat phantom SPEAG ELI 4 8. SAR measurement software SPEAG DASY52 V52.6.2.424 9. Measurement server SPEAG DASY5 SE UMS 011 BS 10. Body Tissue Equivalent Liquids for 2450MHz band 11. Vector network analyzer Agilent E5071C 12. Dielectric probe kit Agilent 85070C 13. Power meter R&S NRVD 14. Power Sensor R&S NRV-Z51 15. Power Sensor R&S NRV-Z1 16. RF Generator Agilent ESG E4438C 17. Dual directional coupler NARDA FSCM 99899 18. Power amplifier MITEQ AMF-4D-00400600-50-30P 19. Laptop positioning extension SPEAG Laptop Holder
Report template No. .....:	FDT08_12

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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:

Control Nº	Description	Model	Serial Nº	Date of reception
34184/01	WiFi module inside a Laptop PC	Intel® Centrino® Wireless-N 1030 / Lenovo U400 / Yageo Antennas	MAC: BC7737794FFA	2011-08-08

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

Testing period

The performed test started on 2011-08-12 and finished on 2011-08-22.

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. = 22.89 ºC Max. = 25.41 ºC
Relative humidity	Min. = 47.03 % Max. = 61.46 %

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 0.502 W/kg, for the 2450 MHz band and 802.11b 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 and 802.11n 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. Antenna to phantom distance during measurements was 7 mm (< 25 mm).

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[2]
(d)(2)	802.11n[1]				NM[2]
(d)(2)	802.11n*[1]		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 18ºC to 25ºC and the variation shall not exceed +/-2ºC 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	DASY52 V52.6.2.424
Schmid & Partner Engineering AG	Measurement Server	DASY5 SE UMS 011 BS
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 [4]

The laptop device was tested in one position for all tests, with the bottom face placed directly against the phantom so the position of the laptop would be used (normal use condition). Further analysis was performed to determine the location which showed the highest SAR.

The antennas on the laptop are located within the edge screen. According to FCC OET Bulletin 65 – Supplement C, the antennas which would applied in the test are antennas or radiating structures in direct contact with the user's body within 20 centimetres of the body of a user under normal operating conditions.

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 de 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_i) 1g	(c_i) 10g	Standard uncertainty (1g) (%)	Standard uncertainty (10g) (%)	v_i v_{eff}
Measurement Equipment								
Probe Calibration	±4.480	Normal	1	1	1	±4.480	±4.480	∞
Axial Isotropy	±7.558	Rectangular	$\sqrt{3}$	1	1	±4.364	±4.364	∞
Hemispherical Isotropy	±2.000	Rectangular	$\sqrt{3}$	1	1	±1.155	±1.155	∞
Boundary effect	±4.700	Rectangular	$\sqrt{3}$	1	1	±2.714	±2.714	∞
Linearity	±1.000	Rectangular	$\sqrt{3}$	1	1	±0.577	±0.577	∞
System detection limits	±0.300	Rectangular	$\sqrt{3}$	1	1	±0.300	±0.300	∞
Readout electronics	±1.010	Normal	1	1	1	±0.583	±0.583	∞
Response time	±2.600	Rectangular	$\sqrt{3}$	1	1	±1.501	±1.501	∞
Integration time	±3.000	Rectangular	$\sqrt{3}$	1	1	±1.732	±1.732	∞
RF Ambien conditions	±3.000	Rectangular	$\sqrt{3}$	1	1	±1.732	±1.732	∞
Probe positioner	±0.800	Rectangular	$\sqrt{3}$	1	1	±0.462	±0.462	∞
Probe positioning	±9.900	Rectangular	$\sqrt{3}$	1	1	±5.716	±5.716	∞
Maximum SAR evaluation	±1.000	Rectangular	$\sqrt{3}$	1	1	±0.577	±0.577	∞
Test Sample Related								
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	$\sqrt{3}$	1	1	±2.887	±2.887	∞
Phantom and Setup								
Phantom uncertainty	±4.000	Rectangular	$\sqrt{3}$	1	1	±2.309	±2.309	∞
Liquid conductivity (deviation from target)	±5.000	Rectangular	$\sqrt{3}$	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	$\sqrt{3}$	0.64	0.43	±1.848	±1.241	∞
Liquid permittivity (measurement error)	±4.410	Normal	1	0.64	0.43	±2.822	±1.896	∞
Combined standard uncertainty	$u_c = \sqrt{\sum_{1=1}^{m} c_i^2 \cdot u_i^2}$					**±11.99**	**±11.56**	330
Expanded uncertainty (confidence interval of 95%)	*ue =2.00 uc*					**±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 ($SAR_{1\ gr.}$) 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)	$SAR_{1\ gr.}$	1.6

Table 4: SAR limit

APPENDIX B: Test results

INDEX

1. TEST CONDITIONS

1.1. Temperature (ºC):

T_n = +22.89 to +25.41

The subscript n indicates normal test conditions.

1.2. 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.

1.3. DUT information

The device under test was the Intel® Centrino® Wireless-N 1030 card located inside a host device (Lenovo U400) computer which utilises a set of Yageo antennas (25.90A72.011 / 25.90A71.011). The card was operated utilizing proprietary software (DRTU version 1.3.9-0235) and each channel was measured using a broadband power meter to determine the maximum average power.

According to host device manufacturer, the source-based time-averaged output power of the Bluetooth device is far bellow the SAR threshold (60/f(GHz) mW). Therefore, neither SAR testing nor co-transmission evaluation is required for the Bluetooth transmitter, following the guidelines stated at FCC OET KDB 447498 – Mobile and Portable Device, RF Exposure Procedures and Equipment Authorization Policies (November 2009), paragraph 4) a).

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%	51.17	1.98	2011-08-22

Note: The dielectric properties have been measured by the contact probe method at 24° 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.	53.00	51.96	-1.97	± 10
10 gr.	25.00	23.88	-4.46	± 10

4. CONDUCTED AVERAGE POWER MEASUREMENTS

Mode	Channel	Frequency (MHz)	Conducted Power (dBm)
802.11b	1	2412	16.61
	6	2437	16.98
	11	2462	16.64
802.11g	1	2412	16.9
	6	2437	16.67
	11	2462	14.18
802.11n[1]	1	2417	14.15
	6	2437	16.79
	11	2457	13.92
802.11n*[1]	3	2422	11.99
	6	2437	14.90
	9	2452	12.43

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	0.502	1.6
	802.11g	-	-	NM[2]	1.6
	802.11n[1]	-	-	NM[2]	1.6
	802.11n*[1]	6	2437	0.334	1.6

1 and 2: See Remarks and Comments.

5.2. Results for 2450 MHz Band – Lapheld

Mode	Channel	Frequency (MHz)	SAR averaged over 1g (W/Kg)	Power Drift (%)	Limit (%)
802.11b	1	2412	NM[3]	-	±5
	6	2437	0.502	0.23	±5
	11	2462	NM[3]	-	±5
802.11g	1	2412	NM[2]	-	±5
	6	2437	NM[2]	-	±5
	11	2462	NM[2]	-	±5
802.11n[1]	1	2417	NM[2]	-	±5
	6	2437	NM[2]	-	±5
	11	2457	NM[2]	-	±5
802.11n*[1]	3	2422	NM[3]	-	±5
	6	2437	0.334	-0.34	±5
	9	2452	NM[3]	-	±5

1, 2 and 3: See Remarks and Comments.

APPENDIX C: Measurements Reports

2450 MHz Band – 802.11b Channel 6 – Lapheld

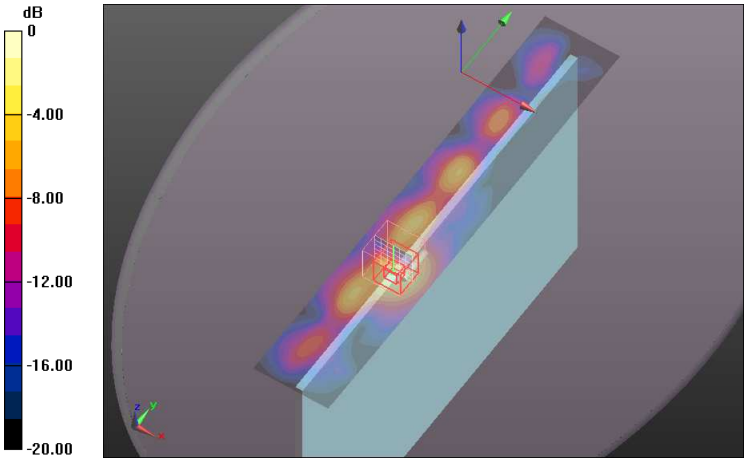
DUT: Lenovo U400 + Intel 12230BNHMW + Yageo; Type: Laptop; Serial: 814PJ01007G0001J

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.967 mho/m; ε_r = 51.209; ρ = 1000 kg/m^3
Phantom section: Flat Section

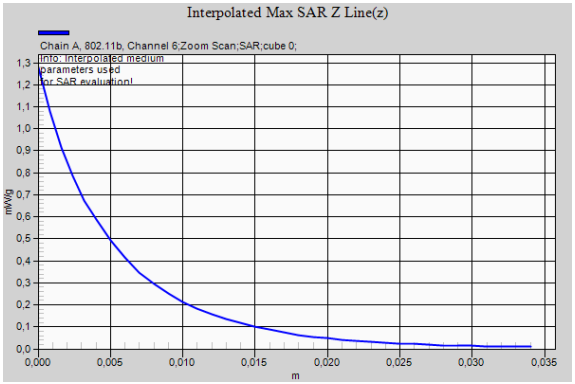
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 03/02/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

2450 MHz - Lapheld/Chain A, 802.11b, Channel 6/Area Scan (61x351x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.580 mW/g

2450 MHz - Lapheld/Chain A, 802.11b, Channel 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.488 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.275 W/kg
SAR(1 g) = 0.502 mW/g; SAR(10 g) = 0.210 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.586 mW/g



0 dB = 0.590mW/g



2450 MHz Band – 802.11n* Channel 6 – Lapheld

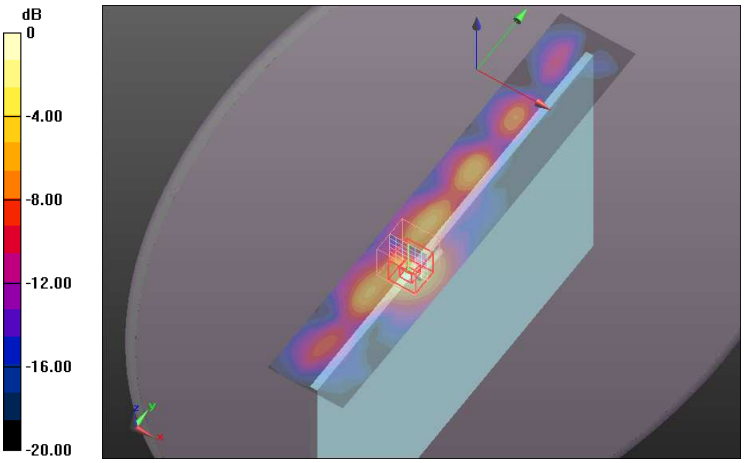
DUT: Lenovo U400 + Intel 12230BNHMW + Yageo; Type: Laptop; Serial: 814PJ01007G0001J

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.967 mho/m; ε_r = 51.209; ρ = 1000 kg/m^3
Phantom section: Flat Section

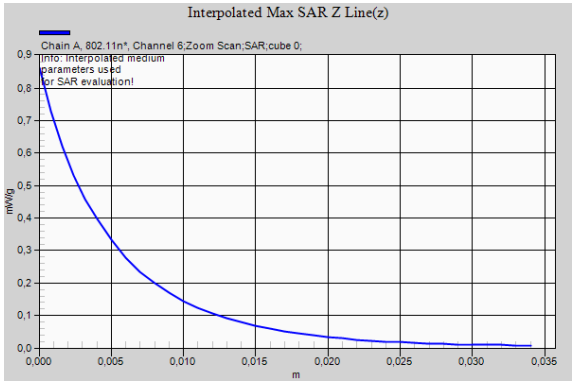
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.14, 4.14, 4.14); Calibrated: 22/10/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 03/02/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

2450 MHz - Lapheld/Chain A, 802.11n*, Channel 6/Area Scan (61x351x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.383 mW/g

2450 MHz - Lapheld/Chain A, 802.11n*, Channel 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.368 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.862 W/kg
SAR(1 g) = 0.334 mW/g; SAR(10 g) = 0.139 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.394 mW/g



0 dB = 0.390mW/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 ± 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 8648C	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

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

Issued: October 23, 2010

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.10	1.23	1.13	± 10.1%
DCP (mV)[B]	97.9	96.1	97.0	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	300.0	± 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%.

[A] The uncertainties of NormX,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 maximum deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz][C]	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%

[C] 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.

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

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz][C]	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%

[C] 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.

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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

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

Issued: June 19, 2009

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 ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

SAR averaged over 1 cm^3 (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 [1]	normalized to 1W	**53.9 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (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 [1]	normalized to 1W	**25.3 mW /g ± 16.5 % (k=2)**

[1] 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^3 (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 [2]	normalized to 1W	**53.0 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (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 [2]	normalized to 1W	**25.0 mW /g ± 16.5 % (k=2)**

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"