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ENSAYOS Nº 51/LE342

TEST REPORT (MODIFICATION 1)

REFERENCE STANDARDS:

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

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

IC RSS-102 Issue 4 (2010-03)

MIE ..... :	35194RRF.001A1
Approved by (name / position & signature) ..... :	A. Llamas / RF Lab Manager
Elaboration date ..... :	2012-03-23

Alejandro Llamas Rodríguez
Firmado digitalmente por Alejandro Llamas Rodríguez
Fecha: 2012.03.23 14:28:46 +01'00'

Identification of item tested ..... :	Intel® Centrino® Wireless-N 2200 inside a host device
Trademark ..... :	Intel
Model and/or type reference ..... :	USA: 2200BNHMW / Canada: 2200BNHU
Serial number ..... :	MAC: 001500A39A30
Other identification of the product ..... :	FCC ID: PD92200BNHU / IC: 1000M-2200BNHU
Features ..... :	802.11 b/g/n
Description ..... :	Wireles Module: Intel® Centrino® Wireless-N 2200 Antenna Type: Yageo 25.90A1E.011 and 25.90A1F.011 Host platform: Lenovo TP00019B PC
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 .....:	
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 447498 – Mobile and Portable Device, RF Exposure Procedures and Equipment Authorization Policies (November 2009). 3. FCC OET KDB 450824 – SAR Probe Calibration and System Verification Considerations for measurements at 150 MHz – 3 GHz (January 2007). 4. FCC OET KDB 865664 – SAR Measurements Requirements for 3-6 GHz (October 2006). 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).
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 4227-16 18. Power amplifier MITEQ AMF-4D-00400600-50-30P 19. Laptop positioning extension SPEAG Laptop Holder
Report template No. .....:	FDT11_11

INDEX

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. PODT000 - Uncertainties calculation.
2. FCC OET Bulletin 65, Supplement C (Edition 01-01), “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”.
3. 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
35194/01	WiFi module inside a host PC	Intel® Centrino® Wireless-N 2200 / Lenovo TP00019B / Yageo Antennas	MAC: 001500A39A30	2012-02-08

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

Testing period

The performed test started on 2012-03-08 and finished on 2012-03-09.

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. = 21.18 ºC Max. = 24.25 ºC
Relative humidity	Min. = 24.16 % Max. = 41.86 %

Modifications to the reference test report

It was introduced the following modifications in respect to the test report 35194RRF001 related with the same samples, in the next clauses and sub-clauses:

CLAUSES / SUB-CLAUSES	MODIFICATION	JUSTIFICATION
Remarks and comments	Included a comment describing the minimum separation distance between antenna and user during testing.	Detail requested by TCB

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 0.289 W/kg, for the 2450 MHz band and 802.11n 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 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".

3: 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.

4: Only the plots of the highest SAR for each test configuration and each chain is included in appendix C, according to FCC OET Bulletin 65, Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields", appendix B.

5: The minimum distance between user and antenna for the Secondary Landscape position, corresponding to the highest measured SAR, is 1mm.

Testing veredicts

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		P		
(d)(2) 802.11n[1]		P		
(d)(2) 802.11n*[1]		P		

1: See Remarks and Comments.

APPENDIX A: Test Configuration

INDEX

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	4227-16
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 [3]

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 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 3: SAR limit

APPENDIX B: Test results

INDEX

1. TEST CONDITIONS

1.1. Temperature (ºC):

T_n = +21.18 to +24.25

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 2200card located inside a host device (Lenovo TP00019B PC) computer which utilises a set of Yageo antennas (Yageo 25.90A1E.011 and 25.90A1F.011). The card was operated utilizing proprietary software (DRTU version 1.5.3-0335) 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 616217 D03 – SAR Evaluation Considerations for Laptop/Notebook/Netbook and Tablet Computers – Supplement to KDB 616217 (November 2009), paragraph 4).

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%	51.8 ± 6%	2.02 ± 6%	51.38	2.01	2012-03-08

Note: The dielectric properties have been measured by the contact probe method at 23° 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.	52.10	55.84	7.18	± 10
10 gr.	24.40	25.07	2.75	± 10

4. CONDUCTED AVERAGE POWER MEASUREMENTS

Mode	Channel	Frequency (MHz)	Conducted Power (dBm)	
			Chain A	Chain B
802.11b	1	2412	15.31	14.75
	6	2437	15.89	15.48
	11	2462	15.74	15.20
802.11g	1	2412	14.1	13.93
	6	2437	16.18	16.45
	11	2462	14.20	14.09
802.11n[1]	1	2417	13.23	12.99
	6	2437	16.70	16.69
	11	2457	13.11	12.68
802.11n*[1]	3	2422	10.30	9.79
	6	2437	13.69	13.83
	9	2452	10.76	10.37

1: See Remarks and Comments.

5. MEASUREMENT RESULTS FOR SAR (SPECIFIC ABSORPTION RATE)

5.1. Summary maximum results

2450 MHz band:

Band	Chain	Mode	Channel	Frequency (MHz)	Measured SAR 1g (W/Kg)	SAR limit 1g (W/Kg)
2450 MHz	A	802.11b	6	2437	0.244	1.6
		802.11g	6	2437	0.253	1.6
		802.11n[1]	6	2437	0.289	1.6
		802.11n*[1]	6	2437	0.155	1.6
	B	802.11b	6	2437	0.165	1.6
		802.11g	6	2437	0.204	1.6
		802.11n[1]	6	2437	0.219	1.6
		802.11n*[1]	6	2437	0.127	1.6

1: See Remarks and Comments.

5.2. Results for 2450 MHz Band – Lapheld Mode

Chain	Mode	Channel	Frequency (MHz)	SAR averaged over 1g (W/Kg)	Power Drift (%)	Power Drift Limit (%)
A	802.11b	1	2412	NM[2]	-	±5
		6	2437	0.0129	3.04	±5
		11	2462	NM[2]	-	±5
	802.11g	1	2412	NM[2]	-	±5
		6	2437	0.0126	2.45	±5
		11	2462	NM[2]	-	±5
	802.11n[1]	1	2417	NM[2]	-	±5
		6	2437	0.0146	-0.62	±5
		11	2457	NM[2]	-	±5
	802.11n*[1]	3	2422	NM[2]	-	±5
		6	2437	0.0106	2.80	±5
		9	2452	NM[2]	-	±5
B	802.11b	1	2412	NM[2]	-	±5
		6	2437	0.0095	2.57	±5
		11	2462	NM[2]	-	±5
	802.11g	1	2412	NM[2]	-	±5
		6	2437	0.0105	1.01	±5
		11	2462	NM[2]	-	±5
	802.11n[1]	1	2417	NM[2]	-	±5
		6	2437	0.00935	3.75	±5
		11	2457	NM[2]	-	±5
	802.11n*[1]	3	2422	NM[2]	-	±5
		6	2437	0.00617	1.62	±5
		9	2452	NM[2]	-	±5

1 and 2: See Remarks and Comments.

5.3. Results for 2450 MHz Band – Secondary Landscape Mode

Chain	Mode	Channel	Frequency (MHz)	SAR averaged over 1g (W/Kg)	Power Drift (%)	Power Drift Limit (%)
A	802.11b	1	2412	NM[2]	-	±5
		6	2437	0.244	0.05	±5
		11	2462	NM[2]	-	±5
	802.11g	1	2412	NM[2]	-	±5
		6	2437	0.253	-1.83	±5
		11	2462	NM[2]	-	±5
	802.11n[1]	1	2417	NM[2]	-	±5
		6	2437	0.289	-2.28	±5
		11	2457	NM[2]	-	±5
	802.11n*[1]	3	2422	NM[2]	-	±5
		6	2437	0.155	-1.01	±5
		9	2452	NM[2]	-	±5
B	802.11b	1	2412	NM[2]	-	±5
		6	2437	0.165	2.57	±5
		11	2462	NM[2]	-	±5
	802.11g	1	2412	NM[2]	-	±5
		6	2437	0.204	0.10	±5
		11	2462	NM[2]	-	±5
	802.11n[1]	1	2417	NM[2]	-	±5
		6	2437	0.219	0.40	±5
		11	2457	NM[2]	-	±5
	802.11n*[1]	3	2422	NM[2]	-	±5
		6	2437	0.127	-1.60	±5
		9	2452	NM[2]	-	±5

1 and 2: See Remarks and Comments.

5.4. Results for 2450 MHz Band – Secondary Portrait Mode

Chain	Mode	Channel	Frequency (MHz)	SAR averaged over 1g (W/Kg)	Power Drift (%)	Power Drift Limit (%)
A	802.11b	1	2412	NM[2]	-	±5
		6	2437	0.072	0.69	±5
		11	2462	NM[2]	-	±5
	802.11g	1	2412	NM[2]	-	±5
		6	2437	0.0811	0.79	±5
		11	2462	NM[2]	-	±5
	802.11n[1]	1	2417	NM[2]	-	±5
		6	2437	0.0913	-0.54	±5
		11	2457	NM[2]	-	±5
	802.11n*[1]	3	2422	NM[2]	-	±5
		6	2437	0.0555	1.16	±5
		9	2452	NM[2]	-	±5
B	802.11b	1	2412	NM[2]	-	±5
		6	2437	0.0245	0.07	±5
		11	2462	NM[2]	-	±5
	802.11g	1	2412	NM[2]	-	±5
		6	2437	0.0268	1.62	±5
		11	2462	NM[2]	-	±5
	802.11n[1]	1	2417	NM[2]	-	±5
		6	2437	0.0267	-0.56	±5
		11	2457	NM[2]	-	±5
	802.11n*[1]	3	2422	NM[2]	-	±5
		6	2437	0.025	4.23	±5
		9	2452	NM[2]	-	±5

1 and 2: See Remarks and Comments.

5.5. Simultaneous transmission considerations

As stated at FCC OET KDB 616217 D03 – SAR Evaluation Considerations for Laptop/Notebook/Netbook and Tablet Computers – Supplement to KDB 616217 (November 2009), paragraph 4), the simultaneous SAR transmission evaluation is not required when:

1. The sum of stand-alone 1-g SAR is < SAR limit

   or

2. The separation distance between each antenna is greater than $5 \cdot [(SAR_1 + SAR_2) / 1.6]^{1.5}$.

The WLAN operation only admits the simultaneous transmission between antennas when both of them use the same channel, so the sum of stand-alone SAR was evaluated considering the highest result for each antenna and the corresponding value of the other one with the same channel.

Transmission Mode	Band	Channel	Frequency	Chain	Max. SAR averaged over 1g (W/kg)	$\sum SAR_i$ 1g (W/Kg)	SAR limit 1g (W/Kg)
802.11n[1]	2.4 GHz	6	2437 MHz	A	0.289	0.508	1.6
				B	0.219		

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 616217 D03 – SAR Evaluation Considerations for Laptop/Notebook/Netbook and Tablet Computers – Supplement to KDB 616217 (November 2009). paragraph 4).

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

APPENDIX C: Measurements Reports

2450 MHz Band / Lapheld Mode / Chain A / 802.11n / Channel 6

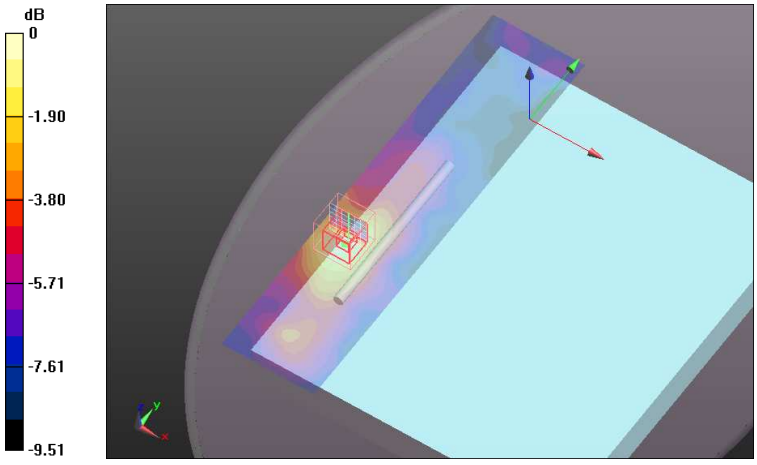
DUT: TP00019B + Intel 2200BNHMW + Yageo; Type: Tablet; Serial: R9-KNLV2 11/12

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.987 mho/m; ε_r = 51.409; ρ = 1000 kg/m^3
Phantom section: Flat Section

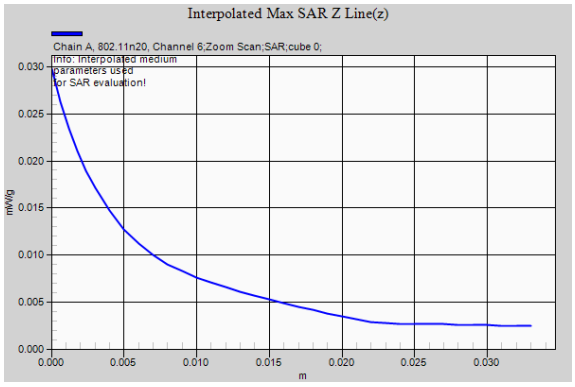
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.15, 4.15, 4.15); Calibrated: 23/11/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 23/11/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

Lapheld/Chain A, 802.11n20, Channel 6/Area Scan (51x221x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.019 mW/g

Lapheld/Chain A, 802.11n20, Channel 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.860 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.030 W/kg
SAR(1 g) = 0.015 mW/g; SAR(10 g) = 0.00917 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.018 mW/g



0 dB = 0.020mW/g



2450 MHz Band / Lapheld Mode / Chain B / 802.11g / Channel 6

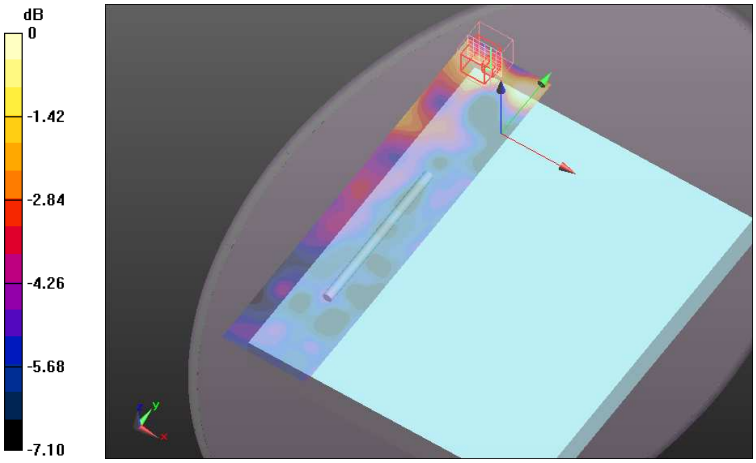
DUT: TP00019B + Intel 2200BNHMW + Yageo; Type: Tablet; Serial: R9-KNLV2 11/12

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.987 mho/m; ε_r = 51.409; ρ = 1000 kg/m^3
Phantom section: Flat Section

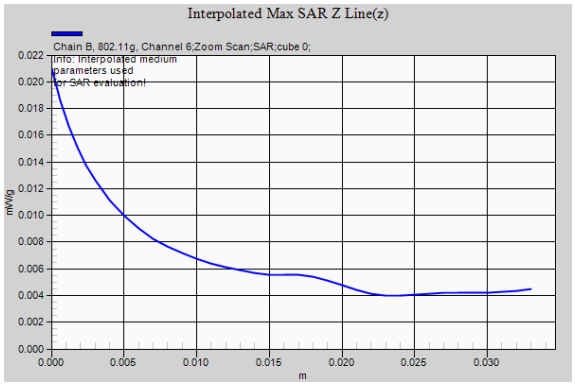
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.15, 4.15, 4.15); Calibrated: 23/11/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 23/11/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

Lapheld/Chain B, 802.11g, Channel 6/Area Scan (51x221x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.011 mW/g

Lapheld/Chain B, 802.11g, Channel 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.230 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.021 W/kg
SAR(1 g) = 0.011 mW/g; SAR(10 g) = 0.00711 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.012 mW/g



0 dB = 0.010mW/g



2450 MHz Band / Secondary Landscape Mode / Chain A / 802.11n / Channel 6

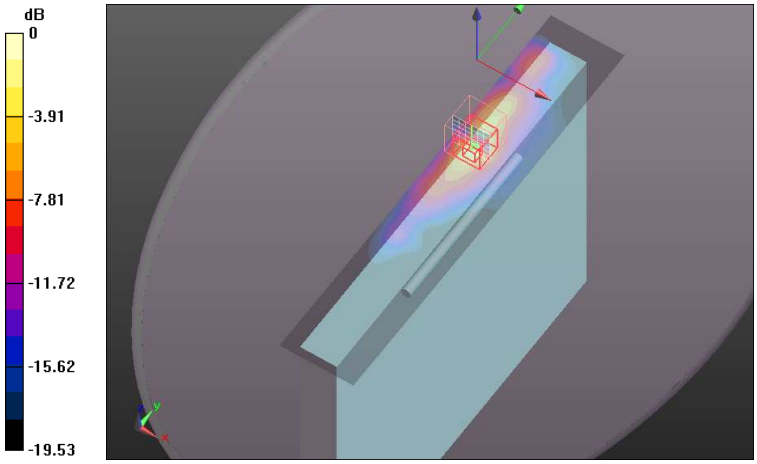
DUT: TP00019B + Intel 2200BNHMW + Yageo; Type: Tablet; Serial: R9-KNLV2 11/12

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.987 mho/m; ε_r = 51.409; ρ = 1000 kg/m^3
Phantom section: Flat Section

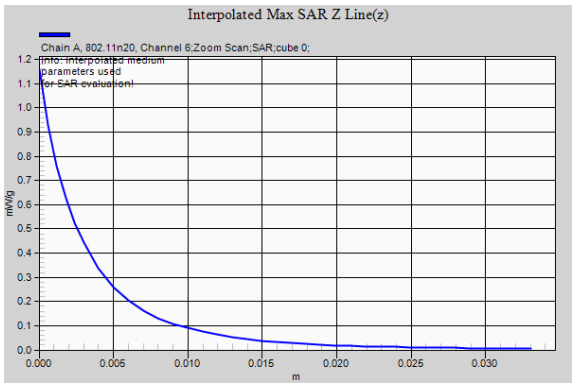
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.15, 4.15, 4.15); Calibrated: 23/11/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 23/11/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

Secondary Landscape/Chain A, 802.11n20, Channel 6/Area Scan (41x221x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.355 mW/g

Secondary Landscape/Chain A, 802.11n20, Channel 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.893 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 1.156 W/kg
SAR(1 g) = 0.289 mW/g; SAR(10 g) = 0.105 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.448 mW/g



0 dB = 0.450mW/g



2450 MHz Band / Secondary Landscape Mode / Chain B / 802.11n / Channel 6

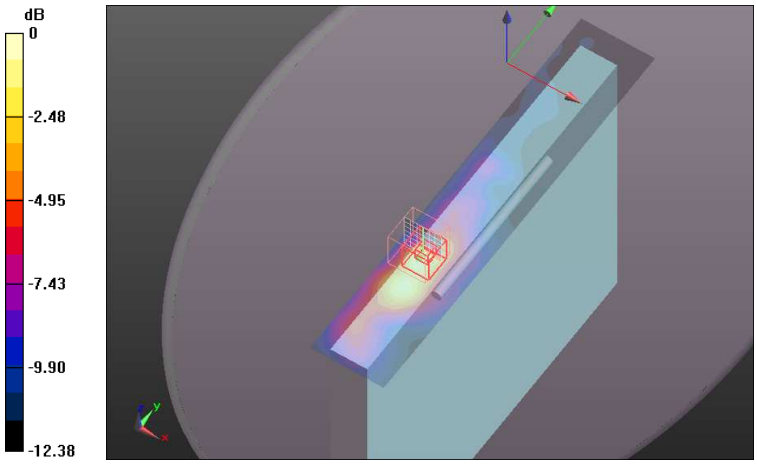
DUT: TP00019B + Intel 2200BNHMW + Yageo; Type: Tablet; Serial: R9-KNLV2 11/12

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.987 mho/m; ε_r = 51.409; ρ = 1000 kg/m^3
Phantom section: Flat Section

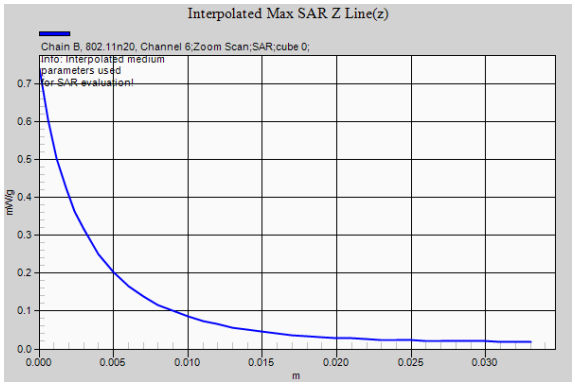
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.15, 4.15, 4.15); Calibrated: 23/11/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 23/11/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

Secondary Landscape/Chain B, 802.11n20, Channel 6/Area Scan (41x221x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.249 mW/g

Secondary Landscape/Chain B, 802.11n20, Channel 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.786 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.739 W/kg
SAR(1 g) = 0.219 mW/g; SAR(10 g) = 0.099 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.306 mW/g



0 dB = 0.310mW/g



2450 MHz Band / Secondary Portrait Mode / Chain A / 802.11n / Channel 6

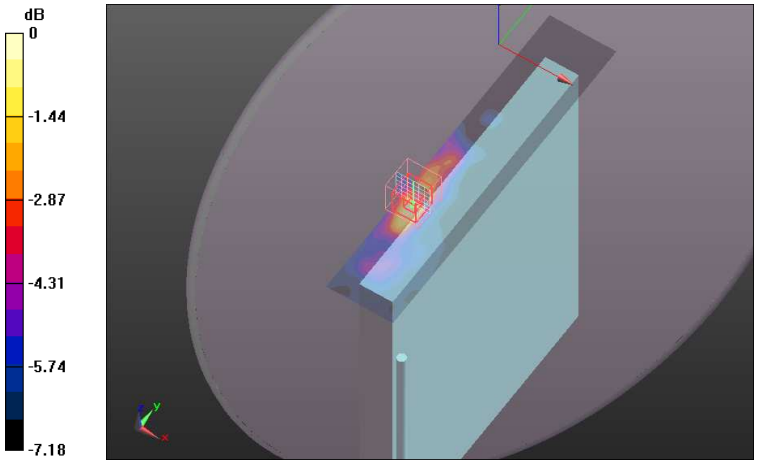
DUT: TP00019B + Intel 2200BNHMW + Yageo; Type: Tablet; Serial: R9-KNLV2 11/12

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.987 mho/m; ε_r = 51.409; ρ = 1000 kg/m^3
Phantom section: Flat Section

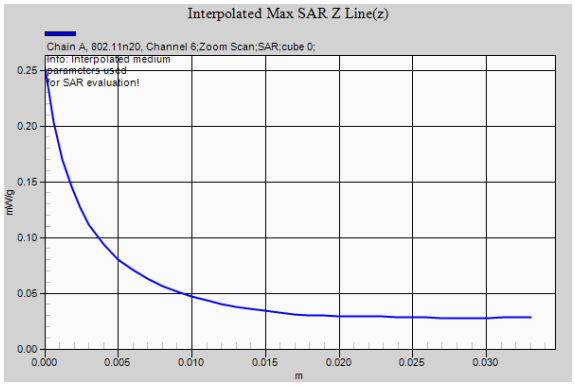
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.15, 4.15, 4.15); Calibrated: 23/11/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 23/11/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

Secondary Portrait/Chain A, 802.11n20, Channel 6/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.109 mW/g

Secondary Portrait/Chain A, 802.11n20, Channel 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.140 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.251 W/kg
SAR(1 g) = 0.091 mW/g; SAR(10 g) = 0.056 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.112 mW/g



0 dB = 0.110mW/g



2450 MHz Band / Secondary Portrait Mode / Chain B / 802.11g / Channel 6

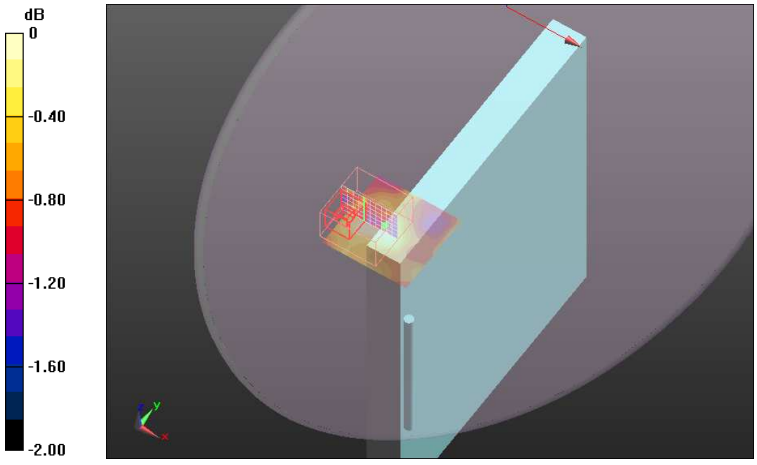
DUT: TP00019B + Intel 2200BNHMW + Yageo; Type: Tablet; Serial: R9-KNLV2 11/12

Communication System: 802.11; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.987 mho/m; ε_r = 51.409; ρ = 1000 kg/m^3
Phantom section: Flat Section

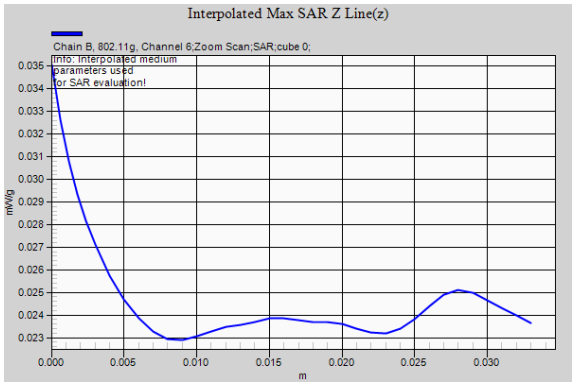
DASY5 Configuration:
- Probe: ES3DV3 - SN3052; ConvF(4.15, 4.15, 4.15); Calibrated: 23/11/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn669; Calibrated: 23/11/2011
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:1060
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.4 (2829)

Secondary Portrait/Chain B, 802.11g, Channel 6/Area Scan (51x51x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.030 mW/g

Secondary Portrait/Chain B, 802.11g, Channel 6/Zoom Scan (11x11x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.379 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.035 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) = 0.029 mW/g



0 dB = 0.030mW/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 AT4 wireless

Certificate No: ES3-3052_Nov11

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3052

Calibration procedure(s) QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date: November 23, 2011

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	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: November 23, 2011

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

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

Accredited by the Swiss Accreditation Service (SAS) **Accreditation No.: SCS 108**
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3052

Manufactured: September 30, 2003
Calibrated: November 23, 2011

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

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]	1.11	1.16	1.17	± 10.1 %
DCP (mV)[B]	103.1	100.4	101.0	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	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	
10011	UMTS-FDD (WCDMA)	3.40	X	3.50	65.9	18.3	111.8	±0.5 %
			Y	3.49	65.3	17.7	119.9	
			Z	3.53	65.8	18.2	117.0	
10012	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	1.87	X	2.98	68.7	18.9	114.9	±0.7 %
			Y	3.27	69.4	18.7	123.6	
			Z	3.11	69.2	18.9	119.9	
10013	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	11.13	X	12.63	72.1	25.3	109.4	±4.6 %
			Y	12.98	72.6	25.4	120.8	
			Z	12.85	72.9	25.9	113.7	
10021	GSM-FDD (TDMA, GMSK)	9.20	X	25.22	99.4	28.3	136.4	±1.2 %
			Y	16.15	90.8	25.7	103.3	
			Z	24.23	99.8	28.2	133.6	
10023	GPRS-FDD (TDMA, GMSK, TN 0)	9.40	X	15.00	89.2	24.4	129.8	±1.7 %
			Y	17.74	91.6	25.5	99.4	
			Z	13.38	87.9	23.6	128.5	
10024	GPRS-FDD (TDMA, GMSK, TN 0-1)	6.40	X	41.65	99.6	24.9	110.1	±2.2 %
			Y	42.81	99.6	25.1	127.5	
			Z	44.23	99.6	24.2	110.8	
10025	EDGE-FDD (TDMA, 8PSK, TN 0)	9.40	X	9.23	79.5	19.6	124.8	±2.5 %
			Y	10.50	80.0	19.8	141.5	
			Z	6.55	74.4	16.8	123.8	
10026	EDGE-FDD (TDMA, 8PSK, TN 0-1)	6.40	X	4.19	67.4	12.6	107.7	±1.4 %
			Y	6.66	71.8	14.7	127.3	
			Z	6.26	72.2	14.0	109.9	
10027	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	4.60	X	62.82	99.7	22.8	121.3	±2.5 %
			Y	59.26	99.9	23.3	137.6	
			Z	16.58	84.6	18.3	123.3	
10028	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	3.40	X	57.16	99.9	22.6	128.1	±2.2 %
			Y	8.77	77.0	15.7	144.3	
			Z	76.33	99.6	21.3	131.3	
10029	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	7.80	X	18.77	99.5	33.3	121.9	±2.5 %
			Y	14.93	92.1	30.2	140.8	
			Z	17.43	99.3	33.5	124.2	

10048	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	13.80	X	15.82	96.5	31.7	102.6	±1.9 %
			Y	14.21	92.7	30.4	80.8	
			Z	14.80	96.9	31.8	99.8	
10049	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	10.80	X	18.15	94.2	27.8	122.6	±1.2 %
			Y	17.25	92.1	27.2	137.0	
			Z	18.28	95.5	28.0	121.1	
10058	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	6.60	X	14.90	93.9	30.4	129.8	±1.7 %
			Y	12.30	87.5	27.5	148.3	
			Z	17.73	99.4	32.7	133.0	
10098	UMTS-FDD (HSUPA)	5.23	X	5.38	66.1	19.1	118.4	±0.9 %
			Y	5.48	66.2	18.9	128.4	
			Z	5.48	66.4	19.2	124.5	
10108	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	8.22	X	8.27	68.4	21.9	123.0	±2.7 %
			Y	8.41	68.5	21.8	134.0	
			Z	8.43	69.0	22.3	129.6	
10109	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	9.07	X	9.60	69.8	23.0	130.5	±3.5 %
			Y	9.71	69.8	22.9	142.6	
			Z	9.75	70.3	23.4	137.7	
10110	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	7.24	X	7.21	67.4	20.8	120.4	±1.9 %
			Y	7.30	67.4	20.6	130.6	
			Z	7.27	67.6	21.0	126.5	
10111	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	7.91	X	8.26	68.4	21.6	126.6	±2.5 %
			Y	8.43	68.6	21.5	138.6	
			Z	8.39	68.8	21.8	133.6	
10112	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	8.95	X	9.63	69.8	23.0	132.3	±3.5 %
			Y	9.76	70.0	22.9	144.8	
			Z	9.77	70.4	23.3	139.2	
10113	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	9.15	X	9.50	69.7	23.1	128.3	±3.5 %
			Y	9.64	69.7	22.9	140.3	
			Z	9.66	70.2	23.5	135.1	
10117	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	10.60	X	12.56	71.7	24.6	113.2	±4.1 %
			Y	12.60	71.6	24.4	124.1	
			Z	12.79	72.3	25.0	119.7	
10154	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	7.40	X	7.32	67.4	20.9	120.4	±1.9 %
			Y	7.43	67.5	20.8	130.8	
			Z	7.42	67.7	21.1	126.6	
10155	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	8.10	X	8.46	68.6	21.9	127.1	±2.7 %
			Y	8.57	68.6	21.7	138.4	
			Z	8.55	68.9	22.0	133.7	
10156	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	7.40	X	7.08	67.1	20.8	117.5	±1.9 %
			Y	7.21	67.2	20.7	127.6	
			Z	7.17	67.4	21.0	123.3	
10157	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	8.37	X	8.34	68.4	22.0	122.3	±2.7 %
			Y	8.52	68.7	21.9	134.1	
			Z	8.49	69.0	22.3	128.7	

10158	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	9.15	X	9.50	69.7	23.1	128.2	±3.5 %
			Y	9.62	69.7	22.9	140.1	
			Z	9.65	70.2	23.4	135.1	
10159	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	8.40	X	8.47	68.7	22.1	123.3	±2.7 %
			Y	8.63	68.8	22.0	134.8	
			Z	8.58	69.1	22.4	129.3	
10175	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	6.50	X	5.83	68.1	21.1	146.3	±1.4 %
			Y	5.52	66.0	19.6	114.5	
			Z	5.46	66.3	20.0	110.2	
10176	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	7.20	X	6.60	69.4	22.1	146.3	±1.9 %
			Y	6.25	67.1	20.6	114.6	
			Z	6.15	67.4	21.0	109.6	
10177	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	6.53	X	5.84	68.0	21.1	146.1	±1.4 %
			Y	5.57	66.1	19.7	114.5	
			Z	5.52	66.4	20.2	109.8	
10178	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	7.73	X	7.03	69.6	22.6	145.8	±2.5 %
			Y	6.68	67.4	21.1	114.5	
			Z	6.58	67.6	21.4	109.5	
10179	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	7.62	X	6.96	69.6	22.5	146.0	±2.2 %
			Y	6.59	67.4	21.0	114.2	
			Z	6.48	67.6	21.3	109.7	
10180	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	7.62	X	6.97	69.6	22.5	146.2	±2.2 %
			Y	6.57	67.3	20.9	113.8	
			Z	6.47	67.5	21.3	109.7	
10196	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	10.20	X	11.73	70.7	23.9	108.2	±3.8 %
			Y	11.83	70.7	23.7	118.4	
			Z	11.89	71.2	24.2	113.8	
10225	UMTS-FDD (HSPA+)	6.70	X	7.71	67.8	20.5	133.7	±1.7 %
			Y	7.91	68.2	20.5	146.6	
			Z	7.79	68.1	20.6	140.1	

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 max. 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) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.10	6.10	6.10	0.34	1.62	± 12.0 %
835	41.5	0.90	5.85	5.85	5.85	0.23	2.15	± 12.0 %
900	41.5	0.97	5.83	5.83	5.83	0.50	1.33	± 12.0 %
1750	40.1	1.37	5.07	5.07	5.07	0.31	2.06	± 12.0 %
1900	40.0	1.40	4.85	4.85	4.85	0.41	1.68	± 12.0 %
2000	40.0	1.40	4.80	4.80	4.80	0.48	1.50	± 12.0 %
2450	39.2	1.80	4.23	4.23	4.23	0.72	1.25	± 12.0 %
2600	39.0	1.96	4.10	4.10	4.10	0.80	1.15	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.05	6.05	6.05	0.45	1.44	± 12.0 %
835	55.2	0.97	5.92	5.92	5.92	0.34	1.77	± 12.0 %
900	55.0	1.05	5.90	5.90	5.90	0.68	1.20	± 12.0 %
1750	53.4	1.49	4.77	4.77	4.77	0.28	2.52	± 12.0 %
1900	53.3	1.52	4.55	4.55	4.55	0.28	2.81	± 12.0 %
2000	53.3	1.52	4.60	4.60	4.60	0.37	2.04	± 12.0 %
2450	52.7	1.95	4.15	4.15	4.15	0.80	0.66	± 12.0 %
2600	52.5	2.16	3.97	3.97	3.97	0.80	0.50	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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Accreditation No.: SCS 108

Client AT4 wireless

Certificate No: D2450V2-756_Aug11

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 756

Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: August 25, 2011

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	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: August 25, 2011

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Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

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	51.8 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**52.1 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.17 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.4 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.1 Ω + 4.1 jΩ
Return Loss	- 26.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.126 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 22, 2004