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SAR Test Report

Report Number: M080325_CERT_533AN_HMW_SAR_2.4

Test Sample: Portable Notebook Computer
Radio Modules: WLAN 533AN_HMW & Bluetooth
EYTF3CS FS
Host Model Number: E8420
Tested For: Fujitsu Australia Pty Ltd
WLAN FCC ID: EJE-WB0056
WLAN IC: 337J-WB0056
Date of Issue: 30th April 2008

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SAR TEST REPORT**Report Number: M080325_CERT_533AN_HMW_SAR_2.4****FCC ID: EJE-WB0056****IC: 337J-WB0056****1.0 GENERAL INFORMATION**

Test Sample: Portable Notebook Computer
Model Name: E8420
Radio Modules: WLAN 533AN_HMW & Bluetooth EYTF3CS FS
Interface Type: Mini-PCI Module
Device Category: Portable Transmitter
Test Device: Pre-Production Unit
FCC ID: EJE-WB0056
IC: 337J-WB0056
RF exposure Category: General Population/Uncontrolled

Manufacturer: Fujitsu Limited

Test Standard/s:

1. Evaluating Compliance with FCC Guidelines For Human Exposure to Radiofrequency Electromagnetic Fields Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01)
2. Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields. RSS-102 Issue 1 (Provisional) September 25, 1999

Statement Of Compliance: The Fujitsu Notebook Computer E8420 with Wireless LAN model 533AN_HMW and Bluetooth module EYTF3CS FS complied* with the FCC General public/uncontrolled RF exposure limits of 1.6mW/g per requirements of 47CFR2.1093(d). It also complied with IC RSS-102 requirements.

*. Refer to compliance statement section 9.

Test Date: 18th March 2008

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SAR TEST REPORT
Portable Notebook Computer
Model: E8420
Report Number: M080325_CERT_533AN_HMW_SAR_2.4

2.0 INTRODUCTION

Testing was performed on the Fujitsu Notebook PC, Model: E8420 with INTEL Mini-PCI Wireless LAN Module (Shirley Peak 802.11a/b/g/n), Model: 533AN_HMW & TAIYO YUDEN Bluetooth Module, Model: EYTF3CS FS. The Shirley Peak module is an OEM product. The Mini-PCI Wireless LAN (WLAN) was tested in the dedicated host – ELEN, Model E8420.

The measurement test results mentioned hereon only apply to the 2450MHz frequency band; an additional report titled “M080325_CERT_533AN_HMW_SAR_5.6” applies to the 5GHz range.

The 533AN_HMW WLAN module was originally certified by Intel as a modular approval under FCC ID: PD9533ANH (Canada ID: 1000M-533ANH). The Radio modules are installed in a controlled environment at the Fujitsu notebook production/assembly factory.

The Bluetooth module was originally certified by TAIYO YUDEN as a modular approval under FCC ID: RYYEYTF3CSFT (Canada ID: 43989A-RYTF3CSF). The Radio modules are installed in a controlled environment at the Fujitsu notebook production/assembly factory.

3.0 SAMPLE TECHNICAL INFORMATION

(Information supplied by the client)

3.1 EUT (WLAN) Details

Transmitter:	Half Mini-Card Wireless LAN Module
Wireless Module:	WiFi Link 5300(Shirley Peak) (11a/b/g/n)
Model Number:	533AN_HMW
Manufacturer:	Intel Corporation
Modulation Type:	Direct Sequence Spread Spectrum (DSSS for 802.11b) Orthogonal Frequency Division Multiplexing (OFDM for 802.11g) Orthogonal Frequency Division Multiplexing (OFDM for 802.11a) Orthogonal Frequency Division Multiplexing (OFDM for 802.11n)
2.4 GHz (802.11b/g/n):	DBPSK, DQPSK, CCK, 16QAM and 64QAM
5 GHz (802.11a/n):	BPSK, QPSK, 16QAM and 64QAM
Maximum Data Rate:	802.11b = 11Mbps, 802.11g and 802.11a = 54Mbps 802.11n = 450 Mbps
Frequency Ranges:	2.412–2.462 GHz for 11b/g/n 5.18-5.32 GHz, 5.50-5.70 GHz and 5.745-5.825 GHz for 11a/n
Number of Channels:	11 channels for 802.11b/g/n 24 channels for 802.11a/n with 20 MHz bandwidth 18 channels for 802.11n with 40 MHz bandwidth
Antenna Types:	Tx1: Nissei Electric Inverted F Antenna – P/N: CP313551 Tx2: Nissei Electric Inverted F Antenna – P/N: CP313552 Tx3: Nissei Electric Inverted F Antenna – P/N: CP313553 Location: Top edge of LCD screen(Tx1, Tx2), Right palm rest(Tx3)
Power Supply:	3.3 VDC from PCI bus



Channels and Output power setting:

Channel and Mode	Frequency MHz	Average Output Power dBm
802.11b/g/n mode		
Channel 1	2412	12.5
Channel 6	2437	16.5
Channel 11	2462	12.5
802.11a/n mode with 20MHz Bandwidth		
Channel 1	2412	12.5
Channel 6	2437	16.5
Channel 13	2462	12.5
Channel 36	5180	14.5
Channel 52	5260	14.5
Channel 64	5320	14.5
Channel 100	5500	16.5
Channel 120	5600	16.5
Channel 140	5700	16.5
Channel 149	5745	16.5
Channel 157	5785	16.5
Channel 165	5825	16.5
802.11n mode with 40MHz Bandwidth		
Channel 3	2422	12.5
Channel 6	2437	16.5
Channel 9	2452	13.5
Channel 38	5190	14.5
Channel 54	5270	16.5
Channel 62	5310	13.5
Channel 102	5510	16.5
Channel 118	5590	16.5
Channel 134	5670	16.5
Channel 151	5755	16.5
Channel 159	5795	16.5

3.2 EUT (Bluetooth) Details

Transmitter: Bluetooth
Model Number: EYTF3CS FS
Manufacturer: TAIYO YUDEN
Network Standard: Bluetooth™ RF Test Specification
Modulation Type: Frequency Hopping Spread Spectrum (FHSS)
Frequency Range: 2402 MHz to 2480 MHz
Number of Channels: 79
Carrier Spacing: 1.0 MHz
Antenna Types: Taiyo Yuden Monopole Antenna, Model: CP331590
 Location: Right hinge of LCD screen.
Max. Output Power: 4 dBm
Reference Oscillator: 16 MHz (Built-in)
Power Supply: 3.3 VDC from host.

Frequency allocation:

Channel Number	Frequency (MHz)	Bluetooth Utility power setting
1	2402	Power (Ext, Int) = 0, 96
2	2403	
-	-	
39	2440	
40	2441	
41	2442	
-	-	
78	2479	
79	2480	

3.3 EUT (Notebook PC) Details

EUT: ELEN
Model Name: LifeBook E-series
Model Number: E8420
Serial Number: Pre-production Sample
Manufacturer: FUJITSU LIMITED

CPU Type and Speed: Core2 Duo T9600 2.80GHz
LCD: 15"WUXGA / 15"WSXGA+ / 15"WXGA
Wired LAN: Intel 82567LM : 10 Base-T/100 Base-TX/1000Base-T
Modem: Agere MDC1.5 modem Model: D40
Port Replicator Model: FPCPR63

AC Adapter Model: 80W: SEC100P2-19.0(Sanken), ADP-80NB A(Delta),
 SEC100P3-19.0(Sanken, 3pin)
 100W: SED110P2-19.0(Sanken)

Voltage: 19 V
Current Specs: 4.22A / 5.27
Watts: 80W / 100W



3.4 Test sample Accessories

3.4.1 Battery Types

One type of Fujitsu Lithium Ion Battery is used to power the Portable Notebook Computer Wireless LAN Model: 533AN_HMW. SAR measurements were performed with the battery as shown below.

Standard Battery

Model	Erie-6cell	Erie-8cell
	B Unit Sample	C0 Unit Sample
Serial No.	W01A-L02AE	W01A-L08AE

4.0 TEST SIGNAL, FREQUENCY AND OUTPUT POWER

INTEL's CRTU test tool was used to configure the WLAN for testing. The Portable Tablet Computer Wireless LAN had a total of 11 channels (USA model) within the 2412 to 2462 MHz frequency band and 28 channels within the frequency range 5180 – 5825 MHz. In The frequency range 2412 MHz to 2462 MHz the device operates in 2 modes, OFDM and DSSS. Within the 5180 – 5825 MHz frequency range the device operates in OFDM mode only. For the SAR measurements the device was operating in continuous transmit mode using programming codes supplied by Fujitsu. The fixed frequency channels used in the testing are shown in Table Below.

The Bluetooth module operates over 79 channels within the frequency range 2402 to 2480 MHz. It is possible for the Bluetooth module to operate simultaneously with the WLAN module (co-transmission), however the distance between the WiFi antennas and the Bluetooth antennas was more than 100mm consequently the tests were conducted with only the WLAN operating but not with the WLAN and Bluetooth module operating in co-transmission. The average power measured at the Bluetooth RF connector was less than 5mW.

The test results mentioned in this report only apply to the 2450MHz frequency range. An additional report titled "M080325_CERT_533AN_HMW_SAR_5.6" is specific to the 5GHz range.

The WLAN modules can be configured in a number of different data rates. It was found that the highest source based time averaged power was measured when using the lowest data rates available in each mode. This lowest data rate corresponds to 6Mbps in OFDM mode and 1Mbps in DSSS mode.

The frequency span of the 2450 MHz range Band was more than 10MHz consequently; the SAR levels of the test sample were measured for lowest, centre and highest channels in the applicable modes. The EUT is capable of using two antennas transmitting simultaneously (HT8 DATA mode) the power level is 3dB lower (50%) than if a single antenna was transmitting, and also the EUT is capable of using three antennas transmitting simultaneously (HT16 DATA mode) the power level is 5dB lower than if a single antenna was transmitting. There were no wires or other connections to the Portable Notebook Computer during the SAR measurements.

At the beginning and at the completion of the SAR tests, the conducted power of the device was measured after temporary modification of antenna connector inside the device's TX RX compartment. Measurements were performed with a calibrated Power Meter. All power levels were found to be equal or higher than the manufacturer specifications (listed in the "Channels and Output power setting" table) to ensure conservative SAR measurement.



4.1 Battery Status

The device battery was fully charged prior to commencement of measurement. Each SAR test was completed within 30 minutes. The battery condition was monitored by measuring the RF field at a defined position inside the phantom before the commencement of each test and again after the completion of the test. It was not possible to perform conducted power measurements at the output of the device, at the beginning and end of each scan due to lack of a suitable antenna port. The uncertainty associated with the power drift was less than 12% and was assessed in the uncertainty budget.

5.0 DETAILS OF TEST LABORATORY

5.1 Location

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5.2 Accreditations

EMC Technologies Pty. Ltd. is accredited by the National Association of Testing Authorities, Australia (NATA).
NATA Accredited Laboratory Number: 5292

EMC Technologies Pty Ltd is NATA accredited for the following standards:

AS/NZS 2772.1:	RF and microwave radiation hazard measurement
ACA:	Radio communications (Electromagnetic Radiation - Human Exposure) Standard 2003
FCC:	Guidelines for Human Exposure to RF Electromagnetic Field OET65C 01/01
EN 50360: 2001	Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)
EN 50361: 2001	Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300MHz – 3GHz)
IEEE 1528: 2003	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Measurement Techniques.

Refer to NATA website www.nata.asn.au for the full scope of accreditation.

5.3 Environmental Factors

The measurements were performed in a shielded room with no background RF signals. The temperature in the laboratory was controlled to within $22\pm 1^{\circ}\text{C}$, the humidity was in the range 54% to 61%. The liquid parameters are measured daily prior to the commencement of each test. Tests were performed to check that reflections within the environment did not influence the SAR measurements. The noise floor of the DASY4 SAR measurement system using the SN1377 probe was less than $5\mu\text{V}$ in both air and liquid mediums.



6.0 DESCRIPTION OF SAR MEASUREMENT SYSTEM

6.1 Probe Positioning System

The measurements were performed with the state-of-the-art automated near-field scanning system **DASY4 V4.7 Build 53** from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision 6-axis robot (working range greater than 1.1m), which positions the SAR measurement probes with a positional repeatability of better than ± 0.02 mm. The DASY4 fully complies with the OET65 C (01-01), IEEE 1528 and EN50361 SAR measurement requirements.

6.2 E-Field Probe Type and Performance

The SAR measurements were conducted with SPEAG dosimetric probe ET3DV6 Serial: 1377 (2.45 GHz) designed in the classical triangular configuration and optimised for dosimetric evaluation. The probes have been calibrated and found to be accurate to better than ± 0.25 dB. The probe is suitable for measurements close to material discontinuity at the surface of the phantom. The sensors of the probe are directly loaded with Schottky diodes and connected via highly resistive lines (length = 300 mm) to the data acquisition unit.

6.3 Data Acquisition Electronics

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. The input impedance of the DAE3 box is 200 M Ω ; the inputs are symmetrical and floating. Common mode rejection is above 80dB. Transmission to the PC-card is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The mechanical probe-mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

6.4 Validation

6.4.1 Validation Results @ 2450MHz

The following tables lists the dielectric properties of the tissue simulating liquid measured prior to SAR validation. The results of the validation are listed in columns 4 and 5. The forward power into the reference dipole for SAR validation was adjusted to 250 mW.

Table: Validation Results (Dipole: SPEAG D2450V2 SN: 724)

1. Validation Date	2. ϵ_r (measured)	3. σ (mho/m) (measured)	4. Measured SAR 1 α (mW/g)	5. Measured SAR 10 α (mW/g)
18 th March 2008	39.5	1.80	13.8	6.49

6.4.2 Deviation from reference validation values

The reference SAR values are derived using a reference dipole and flat section of the SAM phantom suitable for a centre frequency of 2450MHz. These reference SAR values are obtained from the IEEE Std 1528-2003 and are normalized to 1W.

The SPEAG calibration reference SAR value is the SAR validation result obtained in a specific dielectric liquid using the validation dipole (D2450V2) during calibration. The measured one-gram SAR should be within 10% of the expected target reference values shown in table below (2450MHz) below.

Table: Deviation from reference validation values @ 2450MHz

Frequency and Date	Measured SAR 1g (mW/g)	Measured SAR 1g (Normalized to 1W)	SPEAG Calibration reference SAR Value 1g (mW/g)	% Deviation From SPEAG Reference (1g)	IEEE Std 1528 reference SAR value 1g (mW/g)	% Deviation From IEEE (1g)
2450MHz	13.8	55.2	53.3	3.56	52.4	5.34

NOTE: All reference validation values are referenced to 1W input power.

6.4.3 Liquid Depth 15cm

During the SAR measurement process the liquid level was maintained to a level of 15cm with a tolerance of 0.5cm.

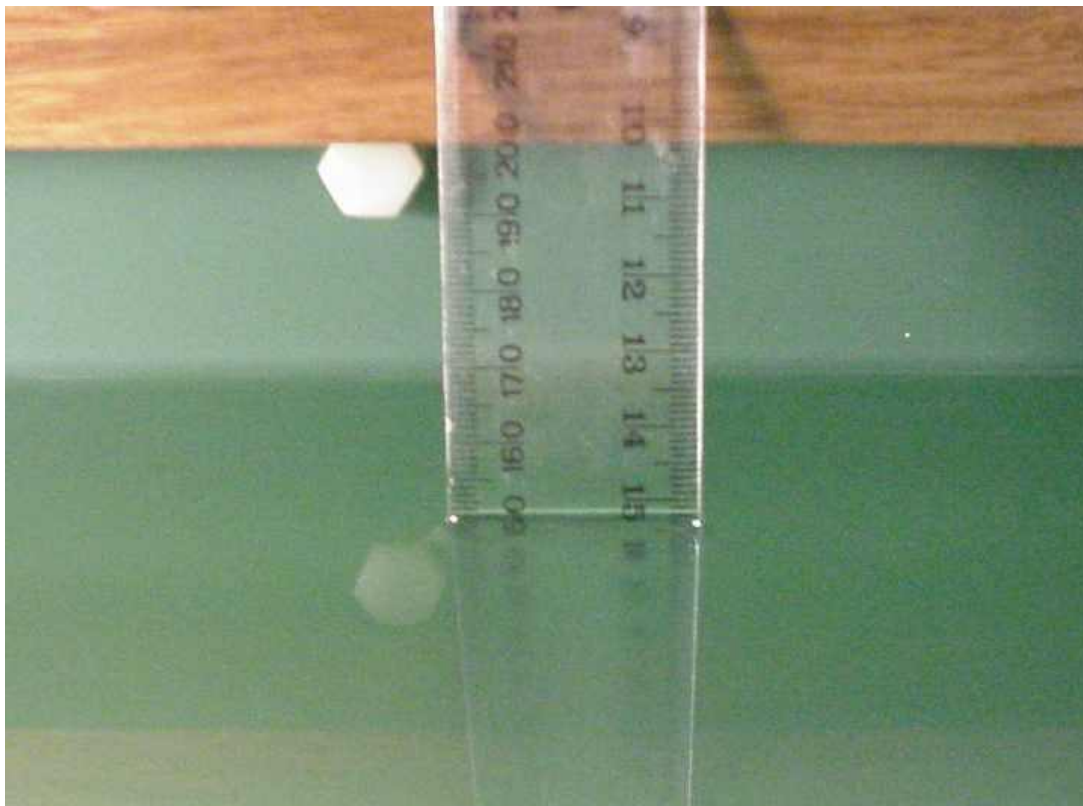


Photo of liquid Depth in Flat Phantom

6.6 Tissue Material Properties

The dielectric parameters of the brain simulating liquid were measured prior to SAR assessment using the HP85070A dielectric probe kit and HP8753ES Network Analyser. The actual dielectric parameters are shown in the following table.

Table: Measured Brain Simulating Liquid Dielectric Values for Validations

Frequency Band	ϵ_r (measured range)	ϵ_r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m ³
2450 MHz Brain	39.5	39.3 \pm 5% (37.3 to 41.3)	1.80	1.84 \pm 5% (1.75 to 1.93)	1000

NOTE: The brain liquid parameters were within the required tolerances of \pm 5%.

Table: Measured Body Simulating Liquid Dielectric Values

Frequency Band	ϵ_r (measured range)	ϵ_r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m ³
2412 MHz Muscle	51.6	52.7 \pm 5% (50.1 to 55.3)	1.90	1.95 \pm 5% (1.85 to 2.05)	1000
2437 MHz Muscle	51.5	52.7 \pm 5% (50.1 to 55.3)	1.93	1.95 \pm 5% (1.85 to 2.05)	1000
2462 MHz Muscle	51.4	52.7 \pm 5% (50.1 to 55.3)	1.97	1.95 \pm 5% (1.85 to 2.05)	1000

NOTE: The brain and muscle liquid parameters were within the required tolerances of \pm 5%.

6.6.1 Liquid Temperature and Humidity

The humidity and dielectric/ambient temperatures were recorded during the assessment of the tissue material dielectric parameters. The difference between the ambient temperature of the liquid during the dielectric measurement and the temperature during tests was less than $|2|^\circ\text{C}$.

Table: Temperature and Humidity recorded for each day

Date	Ambient Temperature ($^\circ\text{C}$)	Liquid Temperature ($^\circ\text{C}$)	Humidity (%)
18 th March 2008	21.4	21.0	57

6.7 Simulated Tissue Composition Used for SAR Test

The tissue simulating liquids are created prior to the SAR evaluation and often require slight modification each day to obtain the correct dielectric parameters.

Table: Tissue Type: Brain @ 2450MHz

Volume of Liquid: 30 Litres

Approximate Composition	% By Weight
Distilled Water	62.7
Salt	0.5
Triton X-100	36.8

Table: Tissue Type: Muscle @ 2450MHz

Volume of Liquid: 60 Litres

Approximate Composition	% By Weight
Distilled Water	73.2
Salt	0.04
DGBE	26.7

*Refer "OET Bulletin 65 97/01 P38"



6.8 Device Holder for Laptops and P 10.1 Phantom

A low loss clamp was used to position the Notebook underneath the phantom surface. Small pieces of foam were then used to press the Notebook flush against the phantom surface.

Refer to Appendix A for photographs of device positioning

7.0 SAR MEASUREMENT PROCEDURE USING DASY4

The SAR evaluation was performed with the SPEAG DASY4 system. A summary of the procedure follows:

- a) A measurement of the SAR value at a fixed location is used as a reference value for assessing the power drop of the EUT. The SAR at this point is measured at the start of the test, and then again at the end of the test.
- b) The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 3.9 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 15 mm x 15 mm. The actual Area Scan has dimensions of 150mm x 195mm surrounding the test device. Based on this data, the area of the maximum absorption is determined by Spline interpolation.
- c) Around this point, a volume of 30 mm x 30 mm x 30 mm is assessed by measuring 7 x 7 x 7 points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:
 - (i) The data at the surface are extrapolated, since the centre of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation is based on a least square algorithm. A polynomial of the fourth order is calculated through the points in z-axis. This polynomial is then used to evaluate the points between the surface and the probe tip.
 - (ii) The maximum interpolated value is searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g and 10 g) are computed using the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the "Not a knot"- condition (in x, y and z-direction). The volume is integrated with the trapezoidal – algorithm. One thousand points (10 x 10 x 10) are interpolated to calculate the averages.
 - (iii) All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.
 - (iv) The SAR value at the same location as in Step (a) is again measured to evaluate the actual power drift.

8.0 MEASUREMENT UNCERTAINTY

The uncertainty analysis is based on the template listed in the IEEE Std 1528-2003 for both Handset SAR tests and Validation uncertainty. The measurement uncertainty of a specific device is evaluated independently and the total uncertainty for both evaluations (95% confidence level) must be less than 30%.

Table: Uncertainty Budget for DASY4 V4.7 Build 53 – EUT SAR test 2450MHz

a	b	c	d	e= f(d,k)	f	g	h=cxf/e	i=cxg/e	k
Uncertainty Component	Sec.	Tol. (%)	Prob. Dist.	Div.	C _i (1g)	C _i (10g)	1g u _i (%)	10g u _i (%)	v _i
Measurement System									
Probe Calibration (k=1) (numerical calibration)	E.2.1	4.8	N	1	1	1	4.8	4.8	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	1	N	1	1	1	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1	1	0.5	0.5	∞
Integration Time	E.2.8	4.32	R	1.73	1	1	2.5	2.5	∞
RF Ambient Conditions	E.6.1	0.05	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	E.6.3	2.9	R	1.73	1	1	1.7	1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	1	R	1.73	1	1	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	1.61	N	1	1	1	1.6	1.6	11
Device Holder Uncertainty	E.4.1	3.34	N	1	1	1	3.3	3.3	7
Output Power Variation – SAR Drift Measurement	6.6.2	7.7	R	1.73	1	1	4.4	4.4	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E.3.1	4	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity – Deviation from target values	E.3.2	5	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity – Measurement uncertainty	E.3.3	10	N	1	0.64	0.43	6.4	4.3	5
Liquid Permittivity – Deviation from target values	E.3.2	5	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity – Measurement uncertainty	E.3.3	5	N	1	0.6	0.49	3.0	2.5	5
Combined standard Uncertainty			RSS				12.5	11.3	154
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				25.0	22.59	

Estimated total measurement uncertainty for the DASY4 measurement system was $\pm 12.5\%$. The extended uncertainty ($K = 2$) was assessed to be $\pm 25.0\%$ based on 95% confidence level. The uncertainty is not added to the measurement result.



Table: Uncertainty Budget for DASY4 V4.7 Build 53 – Validation 2450MHz

a	b	c	D	e= f(d,k)	f	g	h=cxf/e	i=cxg/e	k
Uncertainty Component	Sec.	Tol. (6%)	Prob. Dist.	Div.	C _i (1g)	C _i (10g)	1g u _i (6%)	10g u _i (6%)	v _i
Measurement System									
Probe Calibration (k=1) (standard calibration)	E.2.1	4.8	N	1	1	1	4.8	4.8	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Hemispherical Isotropy	E.2.2	0	R	1.73	1	1	0.0	0.0	∞
Boundary Effect	E.2.3	1	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	1	N	1	1	1	1.0	1.0	∞
Response Time	E.2.7	0	R	1.73	1	1	0.0	0.0	∞
Integration Time	E.2.8	0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions	E.6.1	0.05	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	E.6.3	2.9	R	1.73	1	1	1.7	1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	1	R	1.73	1	1	0.6	0.6	∞
Test Sample Related									
Dipole Axis to Liquid Surface		2	R	1.73	1	1	1.2	1.2	∞
Power Drift		4.7	R	1.73	1	1	2.7	2.7	∞
				□					□
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E.3.1	4	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity – Deviation from target values	E.3.2	5	R	1.73	0.6	0.43	1.7	1.2	∞
Liquid Conductivity – Measurement uncertainty	E.3.3	2.5	N	1.73	0.6	0.43	0.9	0.6	5
Liquid Permittivity – Deviation from target values	E.3.2	5	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity – Measurement uncertainty	E.3.3	2.5	N	1.73	0.6	0.49	0.9	0.7	5
Combined standard Uncertainty			RSS				8.0	7.8	154
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				16.0	15.63	

Estimated total measurement uncertainty for the DASY4 measurement system was $\pm 8.0\%$. The extended uncertainty ($K = 2$) was assessed to be $\pm 16.0\%$ based on 95% confidence level. The uncertainty is not added to the Validation measurement result.



9.0 EQUIPMENT LIST AND CALIBRATION DETAILS

Table: SPEAG DASY4 Version V4.7 Build 53

Equipment Type	Manufacturer	Model Number	Serial Number	Calibration Due	Used For this Test?
Robot - Six Axes	Staubli	RX90BL	N/A	Not applicable	✓
Robot Remote Control	SPEAG	CS7MB	RX90B	Not applicable	✓
SAM Phantom	SPEAG	N/A	1260	Not applicable	✓
SAM Phantom	SPEAG	N/A	1060	Not applicable	
Flat Phantom	AndreT	10.1	P 10.1	Not Applicable	✓
Flat Phantom	AndreT	9.1	P 9.1	Not Applicable	
Flat Phantom	SPEAG	PO1A 6mm	1003	Not Applicable	
Data Acquisition Electronics	SPEAG	DAE3 V1	359	03-July-2008	
Data Acquisition Electronics	SPEAG	DAE3 V1	442	26-Feb-09	✓
Probe E-Field - Dummy	SPEAG	DP1	N/A	Not applicable	
Probe E-Field	SPEAG	ET3DV6	1380	18-Dec-2008	
Probe E-Field	SPEAG	ET3DV6	1377	09-July-2008	✓
Probe E-Field	SPEAG	ES3DV6	3029	Not Used	
Probe E-Field	SPEAG	EX3DV4	3563	13-July-2008	
Antenna Dipole 300 MHz	SPEAG	D300V2	1005	14-Dec-2009	
Antenna Dipole 450 MHz	SPEAG	D450V2	1009	14-Dec-2008	
Antenna Dipole 900 MHz	SPEAG	D900V2	047	6-July-2008	
Antenna Dipole 1640 MHz	SPEAG	D1640V2	314	30-June-2008	
Antenna Dipole 1800 MHz	SPEAG	D1800V2	242	3-July-2008	
Antenna Dipole 1950 MHz	SPEAG	D1950V3	1113	5-March-2009	
Antenna Dipole 3500 MHz	SPEAG	D3500V2	1002	06-July-2008	
Antenna Dipole 2450 MHz	SPEAG	D2450V2	724	13-Dec-2008	✓
Antenna Dipole 5600 MHz	SPEAG	D5GHzV2	1008	07-Dec-2009	
RF Amplifier	EIN	603L	N/A	Not applicable	
RF Amplifier	Mini-Circuits	ZHL-42	N/A	Not applicable	
RF Amplifier	Mini-Circuits	ZVE-8G	N/A	Not applicable	✓
Synthesized signal generator	Hewlett Packard	ESG-D3000A	GB37420238	*In test	✓
RF Power Meter Dual	Hewlett Packard	437B	3125012786	30-May-2008	
RF Power Sensor 0.01 - 18 GHz	Hewlett Packard	8481H	1545A01634	30-May-2008	
RF Power Meter Dual	Gigatronics	8542B	1830125	11-May-2008	✓
RF Power Sensor	Gigatronics	80301A	1828805	11-May-2008	✓
RF Power Meter Dual	Hewlett Packard	435A	1733A05847	*In test	✓
RF Power Sensor	Hewlett Packard	8482A	2349A10114	*In test	✓
Network Analyser	Hewlett Packard	8714B	GB3510035	06-Sept-2008	
Network Analyser	Hewlett Packard	8753ES	JP39240130	02 Oct-2008	✓
Dual Directional Coupler	Hewlett Packard	778D	1144 04700	*In test	
Dual Directional Coupler	NARDA	3022	75453	*In test	✓

* Calibrated during the test for the relevant parameters.



10.0 OET BULLETIN 65 – SUPPLEMENT C TEST METHOD

Notebooks should be evaluated in normal use positions, typical for lap-held bottom-face only. However the number of positions will depend on the number of configurations the laptop can be operated in. The “ELEN” can be used in a conventional laptop position only. The two of the antennas location in the “ELEN” is closest to the top of the screen when used in a conventional laptop configuration and due to the separation distances involved between the phantom and the laptop antenna, testing is not required in this position. The third antenna however (antenna C) is in the base of the PC and requires SAR testing.

10.1 Positions

The “ELEN” Portable PC can only be operated as a conventional notebook laptop. Due to the location of the WLAN transmitter at the base of the notebook, (Antenna C), testing was performed with the base pressed against the surface of the phantom, “Laps On” position.

10.1.1 “Laps On” Position Definition (0mm spacing)

The device was tested in the 2.00 mm flat section of the AndreT Flat phantom P 10.1 for the “Laps On” position. The transceiver was placed at the bottom of the phantom and suspended in such way that the base of the device was touching the phantom. This device orientation simulates the PC’s normal use – being held on the lap of the user. A spacing of 0mm ensures that the SAR results are conservative and represent a worst-case position. *Refer to Appendix A for photos of measurement positions.*

10.2 List of All Test Cases (Antenna In/Out, Test Frequencies, User Modes)

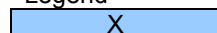
The device has a fixed antenna. Depending on the measured SAR level up to three test channels with the test sample operating at maximum power, as specified in section 4.0 were recorded. The following table represents the matrix used to determine what testing was required.

Table: Testing configurations

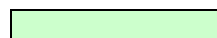
Phantom Configuration	*Device Mode	Antenna	Test Configurations		
			Channel 1 (LOW)	Channel 6 (Middle)	Channel 11 (High)
Laps On	DSSS 2.4GHz	C		X	
	OFDM 2.4GHz (20 MHz)	C		X	
	OFDM 2.4GHz (40 MHz)	C		X	

Note: During co-location verification, Bluetooth was transmitting at 2476 MHz instead of usual 2441 MHz. This was due to interference caused by the Bluetooth transmitter to the WLAN transmitter at 2441 MHz.

Legend



X Testing Required in this configuration



Testing required in this configuration only if SAR of middle channel is more than 3dB below the SAR limit or it is the worst case.



10.3 FCC RF Exposure Limits for Occupational/ Controlled Exposure

Spatial Peak SAR Limits For:	
Partial-Body:	8.0 mW/g (averaged over any 1g cube of tissue)
Hands, Wrists, Feet and Ankles:	20.0 mW/g (averaged over 10g cube of tissue)

10.4 FCC RF Exposure Limits for Un-controlled/Non-occupational

Spatial Peak SAR Limits For:	
Partial-Body:	1.6 mW/g (averaged over any 1g cube of tissue)
Hands, Wrists, Feet and Ankles:	4.0 mW/g (averaged over 10g cube of tissue)

11.0 SAR MEASUREMENT RESULTS

The SAR values averaged over 1g tissue masses were determined for the sample device for all test configurations listed in section 7.2.

11.1 2450MHz SAR Results

There are two modes of operation within the 2450MHz band, they include OFDM and DSSS modulations. Refer to section 7.2 for selection of all device test configurations. Table below displays the SAR results.

Table: SAR MEASUREMENT RESULTS

Test Position	Mode	Plot No.	Ant	Bit rate Mode (Mbps)	Channel Bandwidth (MHz)	Test Channel	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured Drift (dB)
Laps On	OFDM	1	C	6	-	01	2412	0.010	0.318
		2	C	6	-	06	2437	0.027	-0.055
		3	C	6	-	11	2462	0.015	-0.314
Laps On	DSSS	4	C	1	-	06	2437	0.023	0.239
Laps On	OFDM	5	C	6	20 (HT0)	06	2437	0.026	0.115
Laps On	OFDM	6	C	6	40 (HT0)	06	2437	0.025	-0.101

NOTE: The measurement uncertainty of 25.0% for 2.45GHz was not added to the result.

The highest SAR level recorded in the 2450MHz band was 0.027 mW/g as evaluated in a 1g cube of averaging mass. This value was obtained in Laps On position in OFDM mode, utilizing channel 6 (2437 MHz) and antenna C.



12.0 COMPLIANCE STATEMENT

The Fujitsu Notebook PC, Model: E8420 with INTEL Mini-PCI Wireless LAN Module (Shirley Peak 802.11a/b/g/n), Model: 533AN_HMW & TAIYO YUDEN Bluetooth Module, Model: EYTF3CS FS was found to comply with the FCC and RSS-102 SAR requirements.

The highest SAR level recorded was 0.027 mW/g for a 1g cube. This value was measured at 2437 MHz (channel 6) in the "Laps On" position in OFDM modulation mode at the antenna C. This was below the limit of 1.6 mW/g for uncontrolled exposure, even taking into account the measurement uncertainty of 25.0 %.

