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SAR Test Report

Report Number: M030949_ATHEROS_SAR_5.2

Test Sample:	Portable Tablet Computer Wireless LAN
Model Number:	ST5010D
Tested For:	Fujitsu Australia Pty Ltd
FCC ID:	EJE-WL0004
IC:	337J-WL0004
Date of Issue:	19th December 2003

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1.0 GENERAL INFORMATION

Test Sample:	Portable Tablet Computer Wireless LAN
Model Name:	Atheros
Interface Type:	Mini-PCI Module
Device Category:	Portable Transmitter
Test Device:	Production Unit
Model Number:	ST5010D
FCC ID:	EJE-WL0004
IC:	337J-WL0004
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 Portable Tablet Computer Wireless LAN model ST5010D 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: 6^{th}-8^{th}, 15^{th} and 17^{th} October 2003

Tested for:	Fujitsu Australia Pty Ltd
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Contact:	Praveen Rao
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Test Officer:

Peter Jakubiec
Assoc Dip Elec Eng

Authorised Signature:

Aaron Sargent B.Eng
EMR Engineer

SAR TEST REPORT
Portable Tablet Computer Wireless LAN
Model: ST5010D
Report Number: M030949_ATHEROS_SAR_5.2

2.0 DESCRIPTION OF DEVICE

(Information supplied by the client)

2.1 Description of Test Sample

The EUT is a Fujitsu LifeBook incorporating a Mini-PCI wireless LAN (WLAN) module (Atheros ST5010D). The Atheros module is an OEM product. The Mini-PCI wireless LAN (WLAN) module was tested in the dedicated host, a LifeBook ST Series "Ocampa".
The measurement test results mentioned hereon only apply to the 5200/5800MHz frequency band, an additional report titled "M030949_ATHEROS_SAR_2.4" applies to the 2450MHz frequency range.

2.1.1 Summary of EUT Details

Table 1: EUT Details

Device Dimensions (LxWxH) Antenna type Applicable Head Configurations Applicable Body Configurations Battery Options	: 325x222x22mm : Monopole Ceramic chip YCE-5008 : None 1. Tablet Position 2. Lap Arm Held Position : Standard and Extended Battery

Table 2: Modulation Schemes and Frequency Ranges

Frequency Range	Modulation	Rated Power Output (dBm)	TURBO Mode Rated Power Output (dBm)
2.412-2.462 GHz	802.11b - DSSS	18	NO Turbo Mode
	802.11g - OFDM		14.5 max
5.150-5.250 GHz	802.11a – OFDM	14	13.5 max
5.250-5.350 GHz		17	
5.725-5.825 GHz		16	

NOTE: For 2.4GHz SAR results refer to report titled "M030949_ATHEROS_SAR_2.4".

Table 3: 802.11a

Modulation Scheme	Date Rate
BPSK	**6Mbps**, 9Mbps
QPSK	12Mbps, 18Mbps
16QAM	24Mbps, 36Mbps
64QAM	48Mbps, 54Mbps

NOTE: For 2.4GHz SAR results refer to report titled "M030949_ATHEROS_SAR_2.4".

Table 4: 802.11b

Modulation Scheme	Date Rate
DBPSK	**1Mbps**
DQPSK	2Mbps
CCK	5.5Mbps, 11Mbps

Table 5: 802.11g

Modulation Scheme	Date Rate
BPSK	**6Mbps**, 9Mbps
QPSK	12Mbps, 18Mbps
16QAM	24Mbps, 36Mbps
64QAM	48Mbps, 54Mbps

2.1.2 EUT Host Details

Table 6: Host Details

Test Sample:	STYLISTIC ST Series
Models:	ST5010, ST5010D
Codename:	Ocampa
CPU Speed:	Banias ULV 1.0GHz
Manufacturer:	Fujitsu Ltd.
LAN:	Giga-LAN/10/100Base-T
Modem:	MBH7MD33 / MBH7MD35
SDRAM:	256Mb
LCD Screen:	12.1"XGA
Tablet Dock Kit:	TBD

2.2 Test sample Accessories

2.2.1 Battery Types

Two types of Fujitsu Lithium Ion Batteries are used to power the Portable Tablet Computer Wireless LAN Model: ST5010D. SAR measurements were performed with both types of batteries as shown below.

Standard Battery		**Extended Battery**	
Model	CP186220-01	Model	CP186225-01
V/mAh	10.8V/4400mAh	V/mAh	10.8V/6600mAh
Cell No.	6	Cell No.	9

2.3 Test Signal, Frequency and Output Power

The Portable Tablet Computer Wireless LAN had a total of 11 channels (USA model) within the 2412 to 2462 MHz frequency band and 161 channels within the frequency range 5180 – 5805 MHz. The frequency range is 2412 MHz to 2462 MHz and the device operates in 2 modes, OFDM and DSSS. Within the 5180 – 5805 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 7.

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. Table 7 shows the data rates used in the SAR tests.

The test results mentioned in this report only apply to the 5200/5800MHz frequency range. An additional report titled *"M030949_ATHEROS_SAR_2.4"* is specific to the 2450MHz range.

The frequency span of the 2450 MHz range and 5200/5800MHz Bands was more than 10MHz consequently; the SAR levels of the test sample were measured for lowest, centre and highest channels in the applicable modes. There were no wires or other connections to the Portable Tablet Computer during the SAR measurements.

At the beginning and at the completion of the SAR tests, 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. The results of this measurement are listed in table 7.

Table 7: Frequency and Conducted Power Results

Channel	Channel Frequency MHz	*Data Rate (Mbps)	Battery Type	Maximum Conducted Output Power Measured
OFDM Channel 36	5180	6	Standard	15.65
OFDM Channel 48	5240	6	Standard	15.16
OFDM Channel 64	5320	6	Standard	14.83
OFDM Channel 149	5745	6	Standard	13.04
OFDM Channel 157	5785	6	Standard	12.83
OFDM Channel 161	5805	6	Standard	13.03

*NOTE: The highest conducted power was measured in these data rates.

2.4 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.

2.5 Details of Test Laboratory

2.5.1 Location

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Facsimile: +61 3 9338 9260
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website: www.emctech.com.au

2.5.2 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
CENELEC: ES59005: 1998
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.

The 5.2 to 5.8 GHz SAR measurement range is not within the current scope of NATA accreditation.
Refer to NATA website www.nata.asn.au for the full scope of accreditation.

2.5.3 Environmental Factors
The measurements were performed in a shielded room with no background RF signals. The temperature in the laboratory was controlled to within 20.5±1°C, the humidity was in the range 40% to 43%. 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 SN1380 probe was less than 5µV in both air and liquid mediums.

3.0 DESCRIPTION OF SAR MEASUREMENT SYSTEM

3.1 Probe Positioning System
The measurements were performed with the state-of-the-art automated near-field scanning system **DASY4 V4.1 Build 47.1** from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision 6-axis robot (working range greater that 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.

3.2 E-Field Probe Type and Performance
The SAR measurements were conducted with SPEAG dosimetric probe ES3DV3 Serial: 3029 (5.2-5.8 GHz) designed in the classical triangular configuration and optimised for dosimetric evaluation. The probe has 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.

3.3 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 MΩ; 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.

3.4 Calibration and Validation Procedures and Data
Prior to the SAR assessment, the system validation kit was used to verify that the DASY4 was operating within its specifications. The validation was performed at 5200/5800MHz with the SPEAG calibrated dipole D5GHzV2.

The validation dipoles are highly symmetric and matched at the centre frequency for the specified liquid and distance to the phantom. The accurate distance between the liquid surface and the dipole centre is achieved with a distance holder that snaps onto the dipole.

System validation is performed by feeding a known power level into a reference dipole, set at a know distance from the phantom. The measured SAR is compared to the theoretically derived level.

3.4.1 Validation Results @ 5GHz

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 8: Validation Results (Dipole: SPEAG D5GHzV2 SN: 1008)

1. Validation Date	2. $\in$r (measured)	3. σ (mho/m) (measured)	4. Measured SAR 1g (mW/g)	5. Measured SAR 10g (mW/g)
15th October	48.36	5.36	22.8	6.36
17th October	47.08	6.21	20.5	5.57

3.4.2 Deviation from reference validation values

Currently no IEEE Std 1528-2003 SAR reference values are available at 5.2 GHz, as a consequence all 5.8 GHz & 5.2 GHz validation results were compared against the SPEAG calibration reference SAR values.

The SPEAG calibration reference SAR value is the SAR validation result obtained in a specific dielectric liquid using the validation dipole (D5GHzV2) during calibration. The measured one-gram SAR should be within 10% of the expected target reference values shown in (5200/5800MHz) below.

Table 9: Deviation from reference validation values @ 5200MHz and 5800MHz

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)
15th Oct 5200MHz	22.8	91.2	84.8	7.5%
17th Oct 5800MHz	20.5	82.0	80.8	1.5%

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

3.4.3 Liquid Depth 15cm

During the SAR measurement process the liquid level was maintained to a level of a least 15cm with a tolerance of 0.2cm.

3.5 Phantom Properties (Size, Shape, Shell Thickness)

The phantom used during the validations was the SAM Phantom model: TP - 1060 from SPEAG. It is a phantom with a single thickness of 2 mm and was filled with the required tissue simulating liquid. The SAM phantom support structures were all non-metallic and spaced more than one device width away in transverse directions.

For SAR testing in the body worn positions an AndreT Flat phantom PL550 was used. The phantom thickness is 2.0mm+/-0.2 mm and was filled with the required tissue simulating liquid. Table 12 provides a summary of the measured phantom properties. *Refer to Appendix C Part 4, for details of PL550 phantom dielectric properties and loss tangent*.

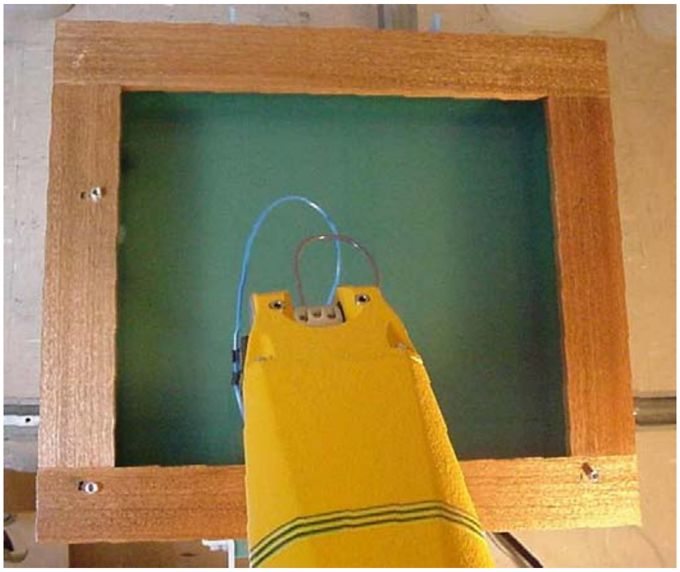
Table 10: Phantom Properties (300MHz-2500MHz)

Phantom Properties	Required	Measured
Thickness of flat section	2.0mm ± 0.2mm (bottom section)	2.12-2.20mm
Dielectric Constant	<5.0	4.603 @ 300MHz (worst-case frequency)
Loss Tangent	<0.05	0.0379 @ 2500MHz (worst-case frequency)

Depth of Phantom	200mm
Length of Flat Section	620mm
Width of Flat Section	540mm

PL550 Flat Phantom

PL550 Flat Phantom



3.6 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 11: Measured Brain Simulating Liquid Dielectric Values for Validations

Frequency Band	∈r (measured range)	∈r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m^3
5200 MHz Brain	48.4	49.0 ±5% (46.55 to 51.45)	5.36	5.30 ±5% (5.04 to 5.57)	1000
5800 MHz Brain	47.1	48.2 ±5% (45.8 to 50.61)	6.21	6.0 ±5% (5.7 to 6.3)	1000

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

Table 12: Measured Body Simulating Liquid Dielectric Values for 5200MHz range

Frequency Band	∈r (measured range)	∈r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m^3
5180 MHz Muscle	51.3	49.0 ±10% (44.1 to 53.9)	5.32	5.3 ±10% (4.77 to 5.83)	1000
5240 MHz Muscle	51.2	48.9 ±10% (44.01 to 53.8)	5.43	5.4 ±10% (4.86 to 5.94)	1000
5320 MHz Muscle	51.0	48.8 ±10% (43.9 to 55.3)	5.58	5.4 ±10% (4.86 to 5.94)	1000

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

Table 13: Measured Body Simulating Liquid Dielectric Values for 5800MHz range

Frequency Band	∈r (measured range)	∈r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m^3
5745 MHz Muscle	44.1	48.3 ±10% (43.47 to 53.13)	6.02	5.9 ±10% (5.31 to 6.49)	1000
5785 MHz Muscle	43.9	48.2 ±10% (43.38 to 53.02)	6.09	6.0 ±10% (5.4 to 6.60)	1000
5805 MHz Muscle	43.9	48.2 ±10% (43.38 to 53.02)	6.12	6.0 ±10% (5.4 to 6.60)	1000

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

3.6.1 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|°C.

Table 14: Temperature and Humidity recorded for each day

Date	Ambient Temperature (°C)	Liquid Temperature (°C)	Humidity (%)
6th October 2003	21.6	21.0	43
7th October 2003	19.5	18.8	40
8th October 2003	20.5	19.8	43
15th October 2003	20.6	19.8	41
17th October 2003	20.5	19.7	41

3.7 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 15: Tissue Type: Muscle @ 5800MHz

Volume of Liquid: 60 Litres

EMCT Liquid

Composition
Distilled Water
Salt
Triton X-100

SPEAG liquid (validation)

Composition
Proprietary

3.8 Device Holder for Laptops and PL550 Phantom

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

Refer to Appendix A4-A7 for photographs of device positioning

4.0 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 71mm x 71mm surrounding the test device. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first "pre-scans" covered an area of 151 mm x 181 mm to ensure that the hotspot was correctly identified.

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 2.0 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-axes. 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.

5.0 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 16: Uncertainty Budget for DASY4 Version V4.1 Build 47.1 – EUT SAR test @ 5200/5800 MHz

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	8.3	N	1	1	1	8.3	8.3	∞
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	2	R	1.73	1	1	1.2	1.2	∞
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	2.6	R	1.73	1	1	1.5	1.5	∞
RF Ambient Conditions	E.6.1	0.075	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.73	1	1	0.5	0.5	∞
Probe Positioning with respect to Phantom Shell	E.6.3	5	R	1.73	1	1	2.9	2.9	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	20	R	1.73	1	1	11.5	11.5	∞
Test Sample Related									
Test Sample Positioning	E.4.2	2	N	1	1	1	2.0	2.0	11
Device Holder Uncertainty	E.4.1	3.6	N	1	1	1	3.6	3.6	7
Output Power Variation – SAR Drift Measurement	6.6.2	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	0.64	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				18.1	17.3	154
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				36.2	34.64	

Estimated total measurement uncertainty for the DASY4 measurement system was ±18.1%. The extended uncertainty (K = 2) was assessed to be ±36.2% based on 95% confidence level. The uncertainty is not added to the measurement result.

Table 17: Uncertainty Budget for DASY4 Version V4.1 Build 47.1 – Validation 5200/5800 MHz

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	8.3	N	1	1	1	8.3	8.3	∞
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	2	R	1.73	1	1	1.2	1.2	∞
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	0.075	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.73	1	1	0.5	0.5	∞
Probe Positioning with respect to Phantom Shell	E.6.3	5	R	1.73	1	1	2.9	2.9	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	20	R	1.73	1	1	11.5	11.5	∞
Test Sample Related									
Dipole Axis to Liquid Distance	E.4.2	2	N	1	1	1	2.0	2.0	∞
Output Power Variation – SAR Drift Measurement	6.6.2	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	0.64	0.43	1.8	1.2	∞
Liquid Conductivity – Measurement uncertainty	E.3.3	10	N	1	0.64	0.43	6.4	4.3	∞
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	∞
Combined standard Uncertainty			RSS				17.4	16.5	∞
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				34.7	33.04	

Estimated total measurement uncertainty for the DASY4 measurement system was ±17.4%. The extended uncertainty (K = 2) was assessed to be ±34.7% based on 95% confidence level. The uncertainty is not added to the measurement result.

6.0 EQUIPMENT LIST AND CALIBRATION DETAILS

Table 18: SPEAG DASY4 Version 4.0 Build 51

Equipment Type	Manufacturer	Model Number	Serial Number	Calibration Due	Used For this Test?
Robot - Six Axes	Staubli	RX90BL	N/A	Not applicable	Yes
Robot Remote Control	SPEAG	CS7MB	RX90B	Not applicable	Yes
SAM Phantom	SPEAG	N/A	1260	Not applicable	No
SAM Phantom	SPEAG	N/A	1060	Not applicable	Yes
Flat Phantom	AndreT	PL870	011	Not Applicable	No
Flat Phantom	AndreT	PL550	10.1	Not Applicable	Yes
Data Acquisition Electronics	SPEAG	DAE3 V1	359	16-July-2004	No
Data Acquisition Electronics	SPEAG	DAE3 V1	442	9–Sept - 2004	Yes
Probe E-Field - Dummy	SPEAG	DP1	N/A	Not applicable	No
Probe E-Field	SPEAG	ET3DV6	1380	18-July-2004	No
Probe E-Field	SPEAG	ET3DV6	1377	6–Sept-03	No
Probe E-Field	SPEAG	ES3DV3	3029	23-Sept-04	Yes
Antenna Dipole 450 MHz	SPEAG	D450V2	1009	24-Jan-05	No
Antenna Dipole 900 MHz	SPEAG	D900V2	047	27-Aug-2004	No
Antenna Dipole 1800 MHz	SPEAG	D1800V2	242	28-Aug-2004	No
Antenna Dipole 2450 MHz	SPEAG	D2450V2	724	9-Nov-2004	No
Antenna Dipole 5800 MHz	SPEAG	D5GHzV2	1008	5-Oct-2005	Yes
RF Amplifier	Mini-Circuits	ZHL-42	N/A	In-test	Yes
Synthesized signal generator	Hewlett Packard	ESG-D3000A	GB37420238	In test	Yes
RF Power Meter Dual	Hewlett Packard	437B	3125012786	25-May-04	Yes
RF Power Sensor 0.01 - 18 GHz	Hewlett Packard	8481H	1545A01634	25-May-04	Yes
RF Power Meter Dual	Gigatronics	8542B	1830125	10-Sept-03	No
RF Power Sensor	Gigatronics	80301A	1828805	10-Sept-03	No
Network Analyser	Hewlett Packard	8753ES	JP39240130	13-June-2004	Yes
Dual Directional Coupler	NARDA	3022	75453	In test	Yes

7.0 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 ST Series laptop “Ocampa” can be used in only a tablet configuration so RF exposure would be limited to the legs when used on the lap. The antenna location in the “Ocampa” is closest to the face of the Tablet screen when compared to the other sides of the device.

The ST series tablets use interactive screen modes that allow the user to place their arms/hands on the tablet screen. To account for occasional exposure to the arms, SAR tests were performed with the tablet screen facing the laptop.

Therefore SAR measurements were performed with the front and back of the laptop facing the flat section of the AndreT Flat phantom (PL550). See Appendix A for photos of test positions.

7.1.1 “Tablet” Position Definition (0mm spacing)

The device was tested in the 2.00 mm flat section of the AndreT Flat phantom PL550 for the “Tablet” position. The Transceiver was placed at the bottom of the phantom and suspended in such way that the back of the device was touching the phantom. This device orientation simulates the tablet’s normal use – being held on the lap of the user whilst in the tablet configuration. A spacing of 0mm ensures that the SAR results are conservative and represent a worst-case position (with respect to SAR).

7.1.2 “Lap Arm Held” Position (0mm spacing)

The device was tested with the screen of the Tablet touching the flat phantom[1]. This orientation simulates use of the device in interactive or arm-held modes where the arm may be rested against the screen during normal use.

For this position, the Transceiver was placed at the bottom of the PL550 phantom and suspended in such way that the screen of the device was touching the phantom. A spacing of 0mm ensures that the SAR results are conservative and represent a worst-case position.

[1] TCB Workshop Notes 2003, Session 6 “Portable Transmitters”

7.2 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 2.3 were recorded. The following table represents the matrix used to determine what testing was required.

Table 19: Testing configurations

Phantom Configuration	*Device Mode	Battery Type	Test Configurations		
			Channel (Low)	Channel (Middle)	Channel (High)
Lap-Arm Held	OFDM 5GHz LR	Standard	X	X	X
		Extended	X	X	X
	OFDM 5GHz HR	Standard	X	X	X
		Extended	X	X	X
Tablet	OFDM 5GHz LR	Standard		X	
		Extended			
	OFDM 5GHz HR	Standard		X	
		Extended			

Legend

X (blue)	Testing Required in this configuration
(green)	Testing not required in this configuration because SAR of middle channel is more than 3dB below the SAR limit.

7.3 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)

7.4 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)

8.0 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.

8.1 5200/5800MHz SAR Results

Table 20: SAR MEASUREMENT RESULTS – OFDM Mode

1. Test Position	2. Plot No.	3. Battery Type	4. Test Channel	5. Test Freq (MHz)	6. Measured 1g SAR Results (mW/g)	7. Measured Drift (dB)
Lap Arm Held	18	4400mAh	36	5180	1.29	0.30
	19	6600mAh	36	5180	1.24	0.10
	20	4400mAh	48	5240	1.09	-0.001
	21	6600mAh	48	5240	1.08	0.30
	22	4400mAh	64	5320	1.02	0.10
	23	6600mAh	64	5320	1.03	-0.00
Tablet	24	4400mAh	48	5240	0.079	0.70*
Lap Arm Held	26	4400mAh	149	5745	0.946	0.20
	27	6600mAh	149	5745	0.990	0.20
	28	4400mAh	157	5785	0.928	0.30
	29	6600mAh	157	5785	0.907	0.40
	30	4400mAh	161	5805	0.942	0.20
	31	6600mAh	161	5805	0.896	0.30

NOTE: The measurement uncertainty of 36.2% for 5GHz testing is not added to the result.
*NOTE: The excessive drift is due to SAR levels in the noise floor of the measurement system.

The highest SAR level recorded in the 5GHz band was 1.29 mW/g as evaluated in a 1g cube of averaging mass. This value was obtained in OFDM mode, utilizing channel 36 (5180MHz) and the 4400mAh battery type.

9.0 COMPLIANCE STATEMENT

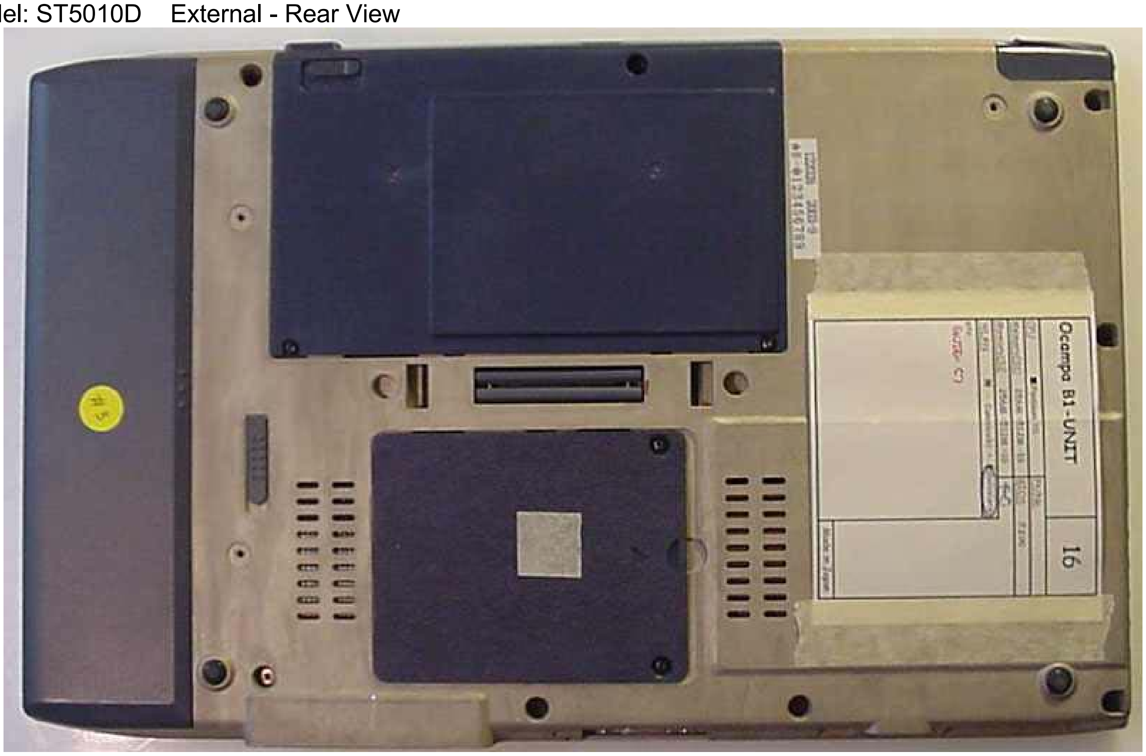
The model ST5010D, FCC ID: EJE-WL0004, IC: 337J-WL0004 Portable Tablet Computer Wireless LAN was found to comply with the FCC and RSS-102 SAR requirements.

The highest SAR level recorded was 1.29 mW/g for a 1g cube. This value was measured at 5180 MHz (channel 36) in the “Lap Arm Held” position in OFDM modulation mode. This was below the limit of 1.6 mW/g for uncontrolled exposure, but was within the band of measurement uncertainty around the limit.

APPENDIX A1
TEST SAMPLE PHOTOGRAPHS

Model: ST5010D External Front View

Model: ST5010D External - Rear View



APPENDIX A2
TEST SAMPLE PHOTOGRAPHS

Model: ST5010D

Front

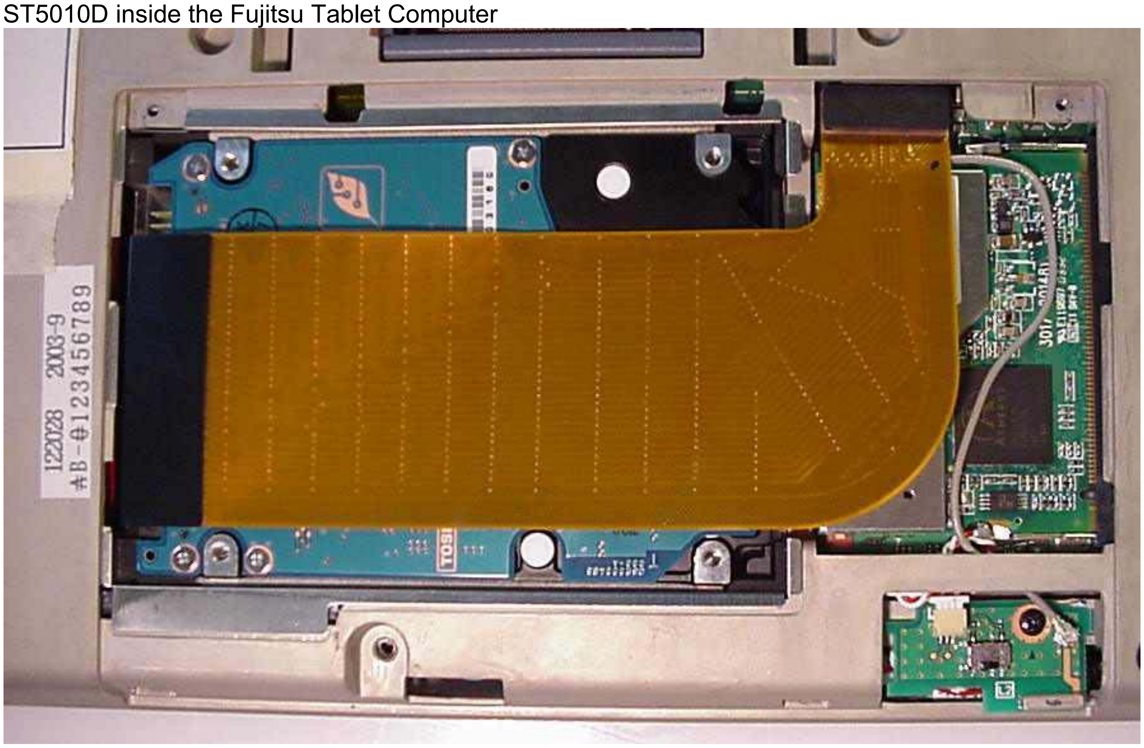
Back

APPENDIX A3
TEST SAMPLE PHOTOGRAPHS

Battery 1

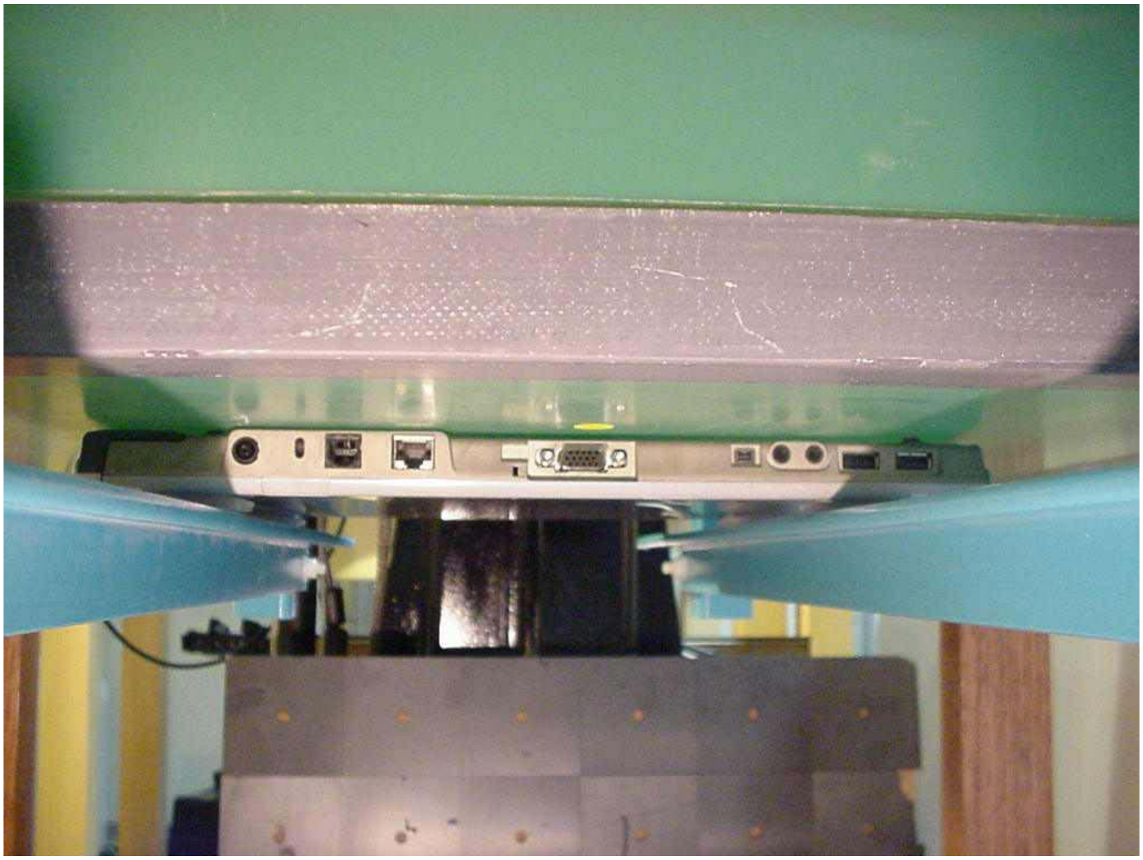
Battery 2

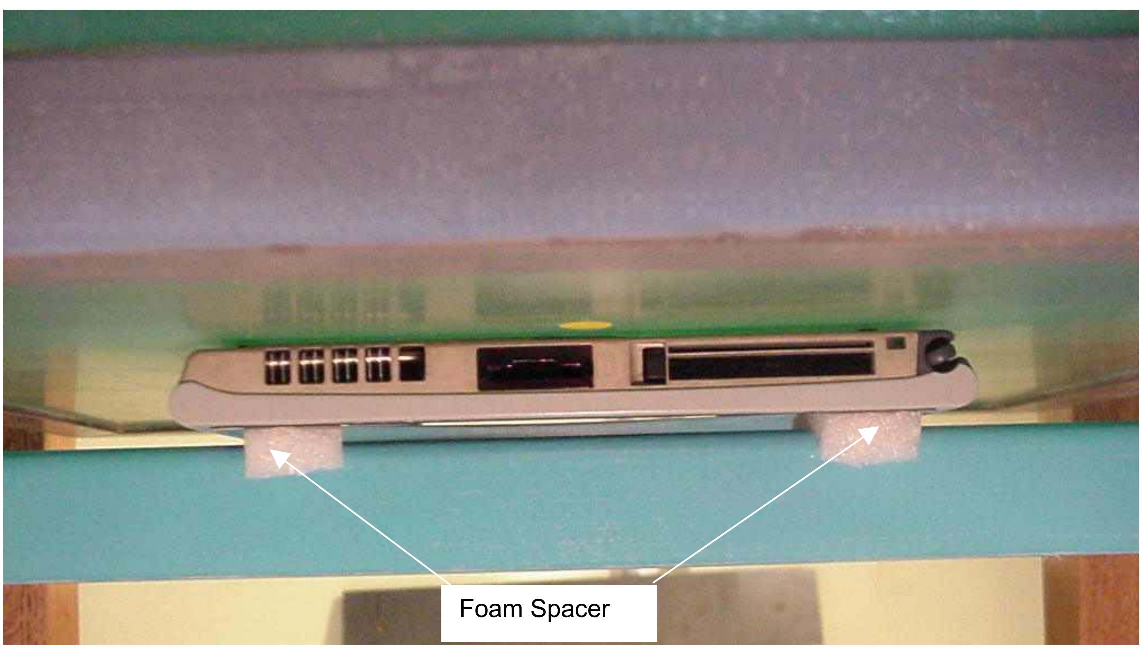
ST5010D inside the Fujitsu Tablet Computer



APPENDIX A4
TEST SETUP PHOTOGRAPHS

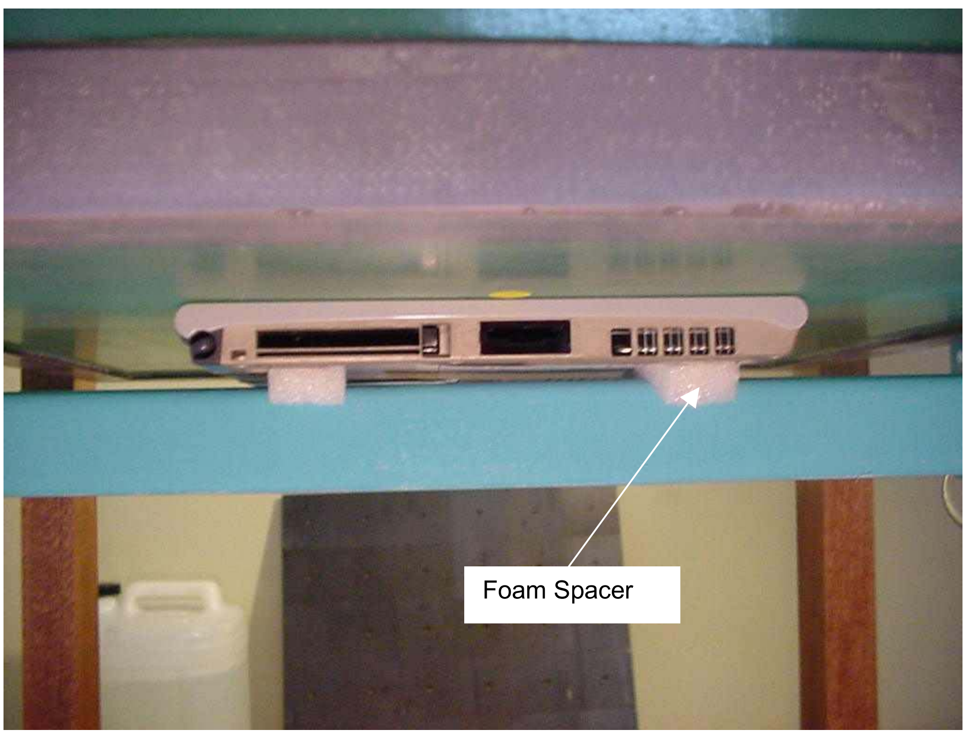
Tablet Position





APPENDIX A5
TEST SAMPLE PHOTOGRAPHS

Arm Held Position



APPENDIX B
PLOTS OF THE SAR MEASUREMENTS

Plots of the measured SAR distributions inside the phantom are given in this Appendix for the "Lap Arm Held" and "Tablet" tested configurations. The spatial peak SAR values were assessed with the procedure described in this report.

NOTE on SAR Plots: The measured SAR levels in the Tablet position were < 0.1mW/g and consequently the "hotspot" was not always clearly defined. The measurement results are only just above the noise floor and the measurement sensitivity of the SAR system. The plots and graphs for these positions were included for information.

NOTE on SAR Graphs: The Z-axis scans listed in this appendix do not always show a consistent decay over distance. This is not due to an incorrect liquid level but is due to the very steep field gradients in the 5-6 GHz band. At distances of greater than 20mm, the SAR levels are in the noise floor, and the calculated levels should be ignored. This is an artefact caused by the DASY4 SEMCAD software algorithms.
According to the DASY4 manufacturer the artifact is "…due to the very rapid decay of the fields within the liquid at this frequency, the values far away from the phantom's surface are so low, that SEMCAD currently identifies them as noise." SPEAG has advised that this problem will be rectified in the next build of the software.

<u>For reference the Validation Z-axis scans show the expected field decay over distance.</u>

Table 21: 5200 MHz Band SAR Measurement Plot Numbers

Plot 1	Lap Arm Held Position – CH#36 – 4400mAh	Page 26
Plot 2	Lap Arm Held Position – CH#36 – 6600mAh	Page 27
Plot 3	Lap Arm Held Position – CH#48 – 4400mAh	Page 28
Plot 4	Lap Arm Held Position – CH#48 – 6600mAh	Page 29
Plot 5	Lap Arm Held Position – CH#64 – 4400mAh	Page 30
Plot 6	Lap Arm Held Position – CH#64 – 6600mAh	Page 31
Plot 7	Tablet Position – CH#48 - 4400mAh	Page 32
Z-Axis Graphs	Z-Axis graphs for Plots 1 to 7	Pages 33-36

Table 22: 5200MHz Validation Plot

Plot 8	Validation 5200MHz 15th October 2003	Page 37
Z-Axis Graphs	Z-Axis graphs for Plot 8	Pages 38

Table 23: 5800 MHz Band SAR Measurement Plot Numbers

Plot 9	Lap Arm Held Position – CH#149 – 4400mAh	Page 39
Plot 10	Lap Arm Held Position – CH#149 – 6600mAh	Page 40
Plot 11	Lap Arm Held Position – CH#157 – 4400mAh	Page 41
Plot 12	Lap Arm Held Position – CH#157 – 6600mAh	Page 42
Plot 13	Lap Arm Held Position – CH#161 – 4400mAh	Page 43
Plot 14	Lap Arm Held Position – CH#161 – 6600mAh	Page 44
Z-Axis Graphs	Z-Axis graphs for Plots 9 to 14	Pages 45-48

Table 24: 5800MHz Validation Plot

Plot 15	Validation 5800MHz 17th October 2003	Page 49
Z-Axis Graphs	Z-Axis graphs for Plot 15	Pages 50