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## SAR Test Report

Report Number: M080405\_CERT\_AR5BHB92\_SAR\_5.6

Test Sample: Portable Tablet Computer

Radio Modules: AR5BHB92 Atheros (2x2) Half Mini-PCI WLAN Module & EYSMJCS Bluetooth Module

Host PC Model Number: T1010

Tested For: Fujitsu Australia Pty Ltd

HOST PC FCC ID: EJE-WB0059

HOST PC IC: 337J-WB0059

Date of Issue: 4<sup>th</sup> June 2008

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## SAR TEST REPORT

**Report Number: M080405\_CERT\_AR5BHB93\_SAR\_5.6**

**HOST PC FCC ID: EJE-WB0059**

**HOST PC IC: 337J-WB0059**

### 1.0 GENERAL INFORMATION

**Test Sample:** Portable Tablet Computer  
**Model Number:** T1010  
**Radio Modules:** WLAN HB92 2x2 Half Mini-PCI WLAN Module, Model: AR5BHB92 (Atheros Communications) & Bluetooth Module, Model EYSMJCS (TAIYO YUDEN)

**Interface Type:** Mini-PCI Module  
**Device Category:** Portable Transmitter  
**Test Device:** Pre-Production Unit  
**FCC ID:** EJE-WB00059  
**HOST PC IC:** 337J-WB0059  
**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. Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) RSS-102 Issue 2 November 2005

**Statement Of Compliance:** The Fujitsu Portable Tablet Computer Model T1010 with Half Mini-PCI Wireless LAN model AR5BHB92 Atheros (2x2) and Bluetooth module EYSMJCS 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.

**Test Dates:** 9<sup>th</sup> April – 23<sup>rd</sup> May 2008

**Tested for:** Fujitsu Australia Pty Ltd  
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**Test Officer:** Peter Jakubiec

**Authorised Signature:**

  
**Peter Jakubiec**  
**EMC Technologies Pty Ltd**



**SAR TEST REPORT**  
**Portable Tablet Computer**  
**Model: T1010**  
**Report Number: M080405\_Cert\_AR5BHB92\_SAR\_5.6**

## 2.0 INTRODUCTION

SAR Testing was performed on the Fujitsu Portable Tablet Computer, Model: T1010 with Atheros Mini-PCI Wireless LAN Module (HB92 802.11a/b/g/n), Model: AR5BHB92 & TAIYO YUDEN Bluetooth Module, Model: EYSMJCS

The Atheros Mini-PCI Wireless LAN Module (HB92 802.11a/b/g/n 2x2), Model: AR5BHB92 is an OEM product. The Mini-PCI Wireless LAN (WLAN) was tested in the dedicated host – LifeBook T Series, Model T1010

The measurement test results mentioned hereon only apply to the 5GHz frequency band; an additional report titled RM080405\_CERT\_AR5BHB92\_SAR\_2.4 applies to the 2450MHz frequency range.

## 3.0 SAMPLE TECHNICAL INFORMATION

(Information supplied by the client)

### 3.1 EUT (WLAN) Details

<b>Transmitter:</b>	Half Mini-Card Wireless LAN Module
<b>FCC ID:</b>	EJE-WB0059
<b>IC:</b>	337J-WB0059
<b>Wireless Module:</b>	HB92 (802.11a/b/g/n)
<b>Model Number:</b>	AR5BHB92
<b>Manufacturer:</b>	AtherosCommunications Inc.
<b>Modulation Type:</b>	Direct Sequence Spread Spectrum (DSSS for 802.11b) Orthogonal Frequency Division Multiplexing (OFDM for 802.11a/g/n)
<b>2.4 GHz (802.11b/g/n):</b>	DBPSK, DQPSK, CCK, 16QAM and 64QAM
<b>5 GHz (802.11a/n):</b>	BPSK, QPSK, 16QAM and 64QAM
<b>Maximum Data Rate:</b>	802.11b = 11Mbps, 802.11g and 802.11a = 54Mbps 802.11n = 300 Mbps
<b>Frequency Ranges:</b>	2.412 –2.462 GHz for 11b/g/n 5.18 - 5.32 GHz and 5.745 - 5.825 GHz for 11a/n
<b>Number of Channels:</b>	11 channels for 11b/g/n 24 channels for 11a/n with 20 MHz bandwidth 18 channels for 11n with 40 MHz bandwidth
<b>Antenna Types:</b>	Tx: Nissei Electric Inverted F Antenna - Model: CP405102 with CP405101 Location: Top edge of LCD screen
<b>Antenna Gain:</b>	Max antenna gain is less than 6 dBi. Refer antenna data provided separately
<b>Power Supply:</b>	3.3 VDC from PCI bus



### 3.2 EUT (Bluetooth) Details

**Transmitter:** Bluetooth  
**Model Number:** EYSMJCS  
**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:** Nissei Electric Inverted F Antenna, Model: CP115428  
 Location: Left palm rest area  
**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

### 3.3 EUT (Notebook PC) Details

**EUT:** Portable Tablet Computer (LifeBook T Series)  
**Model Number:** T1010  
**Serial Number:** Pre-production Sample  
**Manufacturer:** FUJITSU LIMITED

**CPU Type and Speed:** Core2 Duo T9600 2.8GHz  
**LCD** 13" WXGA+ CCFL  
**Wired LAN:** Marvell 88E8055 : 10 Base-T/100 Base-TX/1000Base-T  
**Modem:** Agere MDC1.5 modem Model: D40  
**Port Replicator Model:** FPCPR85

**AC Adapter Model:** SEC100P2-19.0(Sanken) / SEC100P3-19.0(Sanken, 3pin) / ADP-80NB A(Delta) / SED100P2-19.0 (Sanken)  
**Voltage:** 19 V  
**Current Specs:** 4.22A  
**Watts:** 80W

### 3.4 Test sample Accessories

#### 3.4.1 Battery Types

One type of Fujitsu Lithium Ion Battery is used to power the Portable Tablet Computer (LifeBook T Series) with Half Mini-PCI Wireless LAN Model: AR5BHB92. SAR measurements were performed with the battery as shown below.

#### Standard Battery

**Part Number:** CP293420-01  
**V/mAh** 10.8V/5200mAh  
**Cell No.** 6



#### 4.0 TEST SIGNAL, FREQUENCY AND OUTPUT POWER

Atheros' ART 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). For the SAR measurements the device was operating in continuous transmit mode using programming codes supplied by Fujitsu. The tests were conducted with only the WLAN operating and also with the WLAN and Bluetooth module operating in co-transmission. The fixed frequency channels used in the testing are shown in the table below. The Bluetooth interface utilizes dedicated antenna, for the purpose of this report labelled antenna "D".

The test results mentioned in this report only apply to the 5200/5800MHz frequency range. An additional report titled M080405\_Cert\_AR5BHB92\_SAR\_2.4 is specific to the 2450MHz 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. It was found that OFDM using data rate HT0 with 40MHz bandwidth produced the highest SAR level and thus only the results with this modulation is incorporate into the report as the other modulations were tested with different power settings.

The frequency span of the 2450 MHz range and 5600MHz 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. 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. There were no wires or other connections to the Portable NOTEBOOKTYPE 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. The results of this measurement are listed in the following table

**Channels Tested and Output power setting:**

Modes	Channels	Frequency MHz	Average Output Power (dBm)
<b>802.11b/g</b>	1, 6 and 11	2412, 2437 and 2462	14.0
<b>802.11a</b>	36	5180	8.5
	40 and 48	5200 and 5240	13.0
	52, 60 and 64	5260, 5300 and 5320	
	100, 120 and 140	5500, 5600 and 5700	
	149, 157 and 165	5745, 5785 and 5825	14.0
<b>802.11n 20MHz Bandwidth</b>	1 and 6	2412 and 2437	14.0
	11	2462	12.5
	36	5180	10.0
	40 and 48	5200 and 5240	13.5
	52, 60 and 64	5260, 5300 and 5320	
	100, 120 and 140	5500, 5600 and 5700	14.0
	149, 157 and 165	5745, 5785 and 5825	



<b>802.11n 40MHz Bandwidth</b>	3	2422	12.0
	6	2437	14.0
	9	2452	10.5
	38	5190	12.5
	54 and 62	5270 and 5310	14
	102, 118 and 134	5510, 5590 and 5670	
	151 and 159	5755 and 5795	

Refer to EMC Technologies' Report M080405\_CERT\_AR5BHB92\_SAR\_2.4 for 2GHz SAR results

#### 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.

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](http://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  $21 \pm 1^\circ\text{C}$ , the humidity was in the range 39% to 46 %. 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 SN3563 probe was less than  $5\mu\text{V}$  in both air and liquid mediums.

## 6.0 DESCRIPTION OF SAR MEASUREMENT SYSTEM

Applicable Head Configurations	: None
Applicable Body Configurations	: Tablet Position
	: Edge On Side Position

### 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  $\pm 0.02\text{ mm}$ . 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 EX3DV4 Serial: 3563 (5.6 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  $\pm 0.25\text{ dB}$ . 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  $200\text{ M}\Omega$ ; 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 @ 5GHz

The following table 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 D5GHzV2 SN: 1008)**

1. Validation Date	2. $\epsilon_r$ (measured)	3. $\sigma$ (mho/m) (measured)	4. Measured SAR 1g (mW/g)	5. Measured SAR 10g (mW/g)
20 <sup>th</sup> May 2008	35.3	4.45	19.3	5.54
21 <sup>st</sup> May 2008	34.7	4.86	20.7	5.86
22 <sup>nd</sup> May 2008	34.2	5.23	19.7	5.58





#### 6.4.2 Deviation from reference validation values

Currently no IEEE Std 1528-2003 SAR reference values are available in 5.6 GHz band, as a consequence all 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 below.

**Table: Deviation from reference validation values in 5.6 GHz band.**

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)
5200MHz	19.3	77.2	77.6	-0.52
5500MHz	20.7	82.8	79.8	3.76
5800MHz	19.7	78.8	76.3	3.28

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 a least 15cm with a tolerance of 0.5cm.

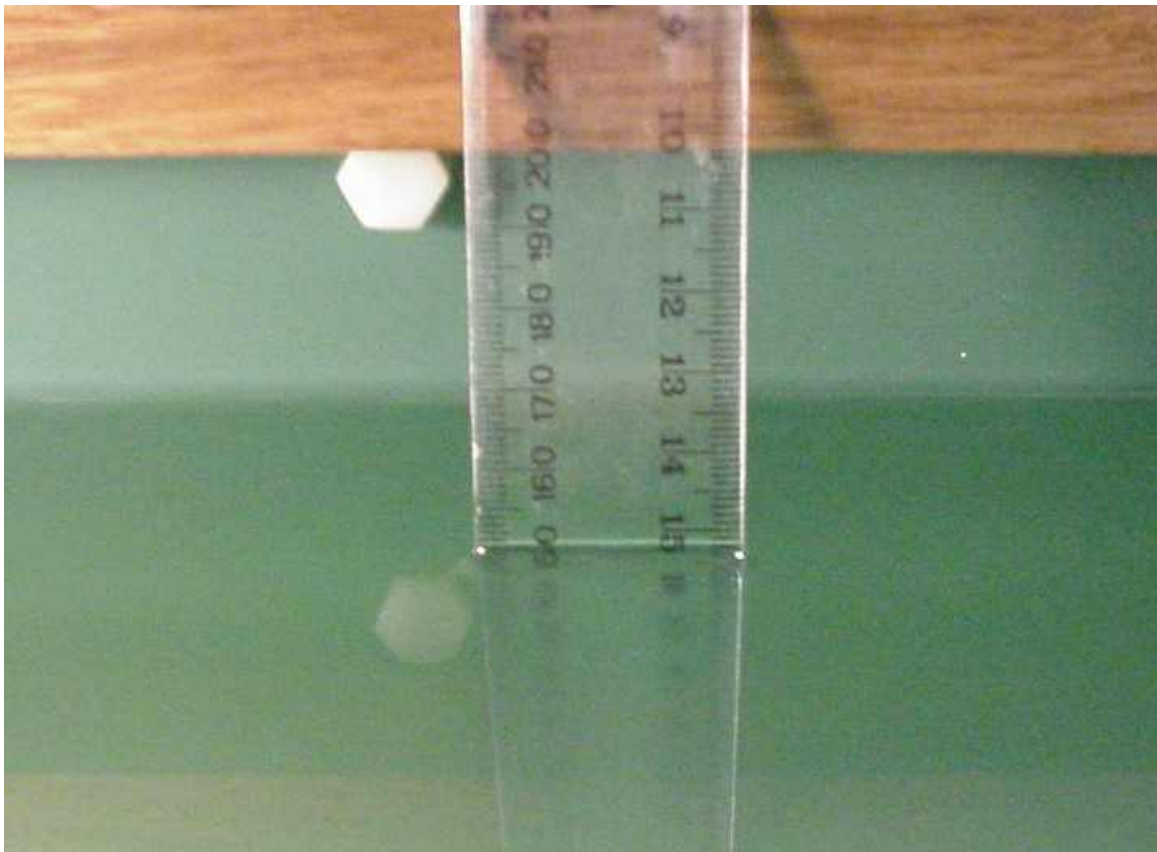


Photo of liquid Depth in Flat Phantom

## 6.5 Phantom Properties (Size, Shape, Shell Thickness)

The phantom used during the validations was the SAM Phantom model: TP - 1260 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 P 10.1 was used. The phantom thickness is 2.0mm+/-0.2 mm and was filled with the required tissue simulating liquid. Table below provides a summary of the measured phantom properties.

**Table: Phantom Properties**

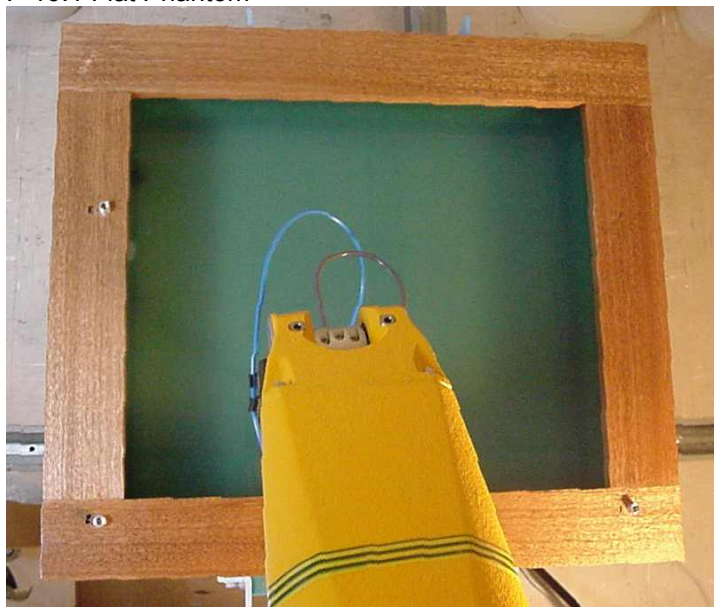
Phantom Properties	Required
Thickness of flat section	2.0mm $\pm$ 0.2mm (bottom section)
Dielectric Constant	<5.0
Loss Tangent	<0.05

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

P 10.1 Flat Phantom



P 10.1 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	$\epsilon_r$ (measured range)	$\epsilon_r$ (target)	$\sigma$ (mho/m) (measured range)	$\sigma$ (target)	$\rho$ kg/m <sup>3</sup>
5200 MHz Brain	35.3	36.0 $\pm$ 5% (34.2 to 37.8)	4.45	4.76 $\pm$ 5% (4.43 to 4.90)	1000
5500 MHz Brain	34.7	35.6 $\pm$ 5% (33.8 to 37.4)	4.86	4.96 $\pm$ 5% (4.71 to 5.21)	1000
5800 MHz Brain	34.2	35.3 $\pm$ 5% (33.5 to 37.1)	5.23	5.27 $\pm$ 5% (5.01 to 5.53)	1000

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

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

Frequency Band	$\epsilon_r$ (measured range)	$\epsilon_r$ (target)	$\sigma$ (mho/m) (measured range)	$\sigma$ (target)	$\rho$ kg/m <sup>3</sup>
5190 MHz Muscle	44.9	49.0 $\pm$ 10% (44.1 to 53.9)	4.92	5.3 $\pm$ 10% (4.77 to 5.83)	1000
5250 MHz Muscle	44.7	48.9 $\pm$ 10% (44.0 to 53.8)	5.06	5.4 $\pm$ 10% (4.86 to 5.94)	1000
5310 MHz Muscle	44.7	48.8 $\pm$ 10% (43.9 to 53.7)	5.12	5.4 $\pm$ 10% (4.86 to 5.94)	1000

**Table: Measured Body Simulating Liquid Dielectric Values for 5600MHz range**

Frequency Band	$\epsilon_r$ (measured range)	$\epsilon_r$ (target)	$\sigma$ (mho/m) (measured range)	$\sigma$ (target)	$\rho$ kg/m <sup>3</sup>
5510 MHz Muscle	44.9	48.6 $\pm$ 10% (43.7 to 53.4)	5.52	5.6 $\pm$ 10% (5.04 to 6.16)	1000
5670 MHz Muscle	44.4	48.5 $\pm$ 10% (43.8 to 53.5)	5.80	5.77 $\pm$ 10% (5.20 to 6.34)	1000
5590 MHz Muscle	44.7	48.4 $\pm$ 10% (43.6 to 53.2)	5.66	5.9 $\pm$ 10% (5.31 to 6.49)	1000

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

Frequency Band	$\epsilon_r$ (measured range)	$\epsilon_r$ (target)	$\sigma$ (mho/m) (measured range)	$\sigma$ (target)	$\rho$ kg/m <sup>3</sup>
5755 MHz Muscle	47.9	48.3 $\pm$ 10% (43.47 to 53.13)	6.03	5.9 $\pm$ 10% (5.31 to 6.49)	1000
5795 MHz Muscle	47.8	48.2 $\pm$ 10% (43.38 to 53.02)	6.11	6.0 $\pm$ 10% (5.4 to 6.60)	1000

NOTE: The muscle liquid parameters were within the required tolerances of  $\pm$ 10%.



### 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 (%)
20 <sup>th</sup> May 2008	21.6	21.3	46.0
21 <sup>st</sup> May 2008	21.7	21.4	46.0
22 <sup>nd</sup> May 2008	21.4	21.1	39.0

### 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: Muscle @ 5600MHz**

Volume of Liquid: 60 Litres

EMCT Liquid

Composition
Distilled Water
Salt
Triton X-100

### 6.8 Device Holder for Laptops and P 10.1 Phantom

A low loss clamp was used to position the Portable Tablet Computer (LifeBook T Series) underneath the phantom surface. Small pieces of foam were then used to press the Portable Tablet Computer (LifeBook T Series) 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 2.0 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 10 mm x 10 mm. The actual Area Scan has dimensions of 100 mm x 140 mm 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 24 mm x 24 mm x 20 mm is assessed by measuring 7 x 7 x 9 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 1.0 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 2.0 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.



## 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.

**Table: Uncertainty Budget for DASY4 Version V4.7 Build 53 – EUT SAR test 5GHz**

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 <sub>i</sub> (1g)	C <sub>i</sub> (10g)	1g u <sub>i</sub> (%)	10g u <sub>i</sub> (%)	v <sub>i</sub>
<b>Measurement System</b>									
Probe Calibration (k=1) (standard calibration)	E.2.1	6.6	N	1	1	1	6.6	6.6	∞
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	5.7	R	1.73	1	1	3.3	3.3	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	4	R	1.73	1	1	2.3	2.3	∞
<b>Test Sample Related</b>									
Dipole Axis to Liquid distance	E.4.2	2	N	1	1	1	2.0	2.0	11
Output Power Variation – SAR Drift Measurement	6.6.2	11.51	R	1.73	1	1	6.6	6.6	∞
<b>Phantom and Tissue Parameters</b>									
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	2.5	N	1	0.64	0.43	1.6	1.1	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	0.6	0.49	1.5	1.2	5
Combined standard Uncertainty			RSS				11.9	11.7	154
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				23.8	23.41	

Estimated total measurement uncertainty for the DASY4 measurement system was 11.9%. The extended uncertainty (K = 2) was assessed to be 23.8% based on 95% confidence level. The uncertainty is not added to the measurement result.





**Table: Uncertainty Budget for DASY4 Version V4.7 Build 53 – Validation 5GHz**

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 <sub>i</sub> (1g)	C <sub>i</sub> (10g)	1g u <sub>i</sub> (%)	10g u <sub>i</sub> (%)	v <sub>i</sub>
<b>Measurement System</b>									
Probe Calibration (k=1) (standard calibration)	E.2.1	6.6	N	1	1	1	6.6	6.6	∞
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	5.7	R	1.73	1	1	3.3	3.3	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	4	R	1.73	1	1	2.3	2.3	∞
<b>Test Sample Related</b>									
Dipole Axis to Liquid distance	E.4.2	2	N	1	1	1	2.0	2.0	11
Output Power Variation – SAR Drift Measurement	6.6.2	4.7	R	1.73	1	1	2.7	2.7	∞
<b>Phantom and Tissue Parameters</b>									
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	2.5	N	1	0.64	0.43	1.6	1.1	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	0.6	0.49	1.5	1.2	5
Combined standard Uncertainty			RSS				10.3	10.0	154
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				20.5	20.02	

Estimated total measurement uncertainty for the DASY4 measurement system was  $\pm 10.3\%$ . 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 LifeBook T Series can be used in either a conventional laptop position (see Appendix A1) or a Tablet configuration. The antenna location in the LifeBook T Series 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.

### 10.0 Position

#### 10.1.1 “Tablet” 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 “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 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.

#### 10.1.2 “Edge On Side” Position

The device was tested in the (2.00 mm) flat section of the AndreT phantom for the “Edge On” position. The Antenna edge of the Transceiver was placed underneath the flat section of the phantom and suspended until the edge touched the phantom. *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 (Low)	Channel (Middle)	Channel (High)
Tablet	OFDM HT0-40MHz 5GHz	Mains		X	
	OFDM HT0-40MHz 5GHz	Aux		X	
Edge On Side	OFDM HT0-40MHz 5GHz	Mains		X	
	OFDM HT0-40MHz 5GHz	Aux		X	

Note: Due to low SAR levels (more than 3dB below the SAR limit) the HT0(20MHz) and OFDM(6Mbps) modes were not investigated.

#### 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:**

<b>Partial-Body:</b>	8.0 mW/g (averaged over any 1g cube of tissue)
<b>Hands, Wrists, Feet and Ankles:</b>	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:**

<b>Partial-Body:</b>	1.6 mW/g (averaged over any 1g cube of tissue)
<b>Hands, Wrists, Feet and Ankles:</b>	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 10.2.

**11.1 GHz Band SAR Results****Table: SAR MEASUREMENT RESULTS Lower Band**

Test Position	Plot No.	Ant	Bit rate Mode (Mbps)	Channel Bandwidth (MHz)	Test Channel	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured Drift (dB)
Tablet	1	Aux	OFDM HT0	40	54	5270	0.000573	0.172
Tablet	2	Main	OFDM HT0	40	54	5270	0.000478	0.434
Edge On Side	3	Aux	OFDM HT0	40	54	5270	0.124	0.168
Edge On Side	4	Aux	OFDM HT0	40	38	5190	0.117	-0.090
Edge On Side	5	Aux	OFDM HT0	40	62	5310	0.130	0.172

NOTE: The measurement uncertainty of 23.8% for 5GHz testing is not added to the result.

The highest SAR level recorded in the 5.2 GHz band was 0.130 mW/g as evaluated in a 1g cube of averaging mass. This value was obtained in Edge On Side position in OFDM mode, utilizing channel 62 (5310 MHz) and auxiliary antenna.



**Table: SAR MEASUREMENT RESULTS Middle Band**

Test Position	Plot No.	Ant	Bit rate Mode (Mbps)	Channel Bandwidth (MHz)	Test Channel	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured Drift (dB)
Edge On Side	6	Aux	OFDM HT0	40	118	5590	0.138	0.473
Tablet	7	Aux	OFDM HT0	40	118	5590	0.031	0.162
Tablet	8	Main	OFDM HT0	40	118	5590	0.018	0.295
Edge On Side	9	Aux	OFDM HT0	40	102	5510	0.139	0.056
Edge On Side	10	Aux	OFDM HT0	40	134	5670	0.141	0.196

NOTE: The measurement uncertainty of 23.8% for 5GHz testing is not added to the result.

The highest SAR level recorded in the 5.6 GHz band was 0.141 mW/g as evaluated in a 1g cube of averaging mass. This value was obtained in Edge On Side position in OFDM mode, utilizing channel 134 (5670 MHz) and auxiliary antenna.

**Table: SAR MEASUREMENT RESULTS Upper Band**

Test Position	Plot No.	Ant	Bit rate Mode (Mbps)	Channel Bandwidth (MHz)	Test Channel	Test Freq (MHz)	Measured 1g SAR Results (mW/g)	Measured Drift (dB)
Tablet	11	Main	OFDM	40	159	5795	0.031	0.075
Tablet	12	Aux	OFDM	40	159	5795	0.034	0.008
Edge On Side	13	Aux	OFDM	40	159	5795	0.138	0.062
Edge On Side	14	Aux	OFDM	40	151	5755	0.144	0.035

NOTE: The measurement uncertainty of 23.8% for 5GHz testing is not added to the result.

The highest SAR level recorded in the 5.8 GHz band was 0.144 mW/g as evaluated in a 1g cube of averaging mass. This value was obtained in Edge On Side position in OFDM mode, utilizing channel 151 (5755 MHz) and with auxiliary antenna.



## 12.0 COMPLIANCE STATEMENT

The Fujitsu Portable Tablet Computer, Model: T1010 with Atheros Mini-PCI Wireless LAN Module (HB92 802.11a/b/g/n), Model: AR5BHB92 & TAIYO YUDEN Bluetooth Module, Model: EYSMJCS was found to comply with the FCC and RSS-102 SAR requirements.

The highest SAR level recorded was 0.144 mW/g for a 1g cube. This value was measured at 5755 MHz (channel 151) in the "Edge On Side" position in OFDM modulation mode at the auxiliary antenna. This was below the limit of 1.6 mW/g for uncontrolled exposure, even taking into account the measurement uncertainty of 23.8 %.



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## APPENDIX A1 TEST SAMPLE PHOTOGRAPHS

Host – Model T1010 - Conventional Laptop Configuration



Host – Model T1010 - Tablet Configuration





## APPENDIX A2 TEST SAMPLE PHOTOGRAPHS

WLAN Model: AR5BHB92

Front



Back





## APPENDIX A3 TEST SAMPLE PHOTOGRAPHS

Battery 1



Battery 2

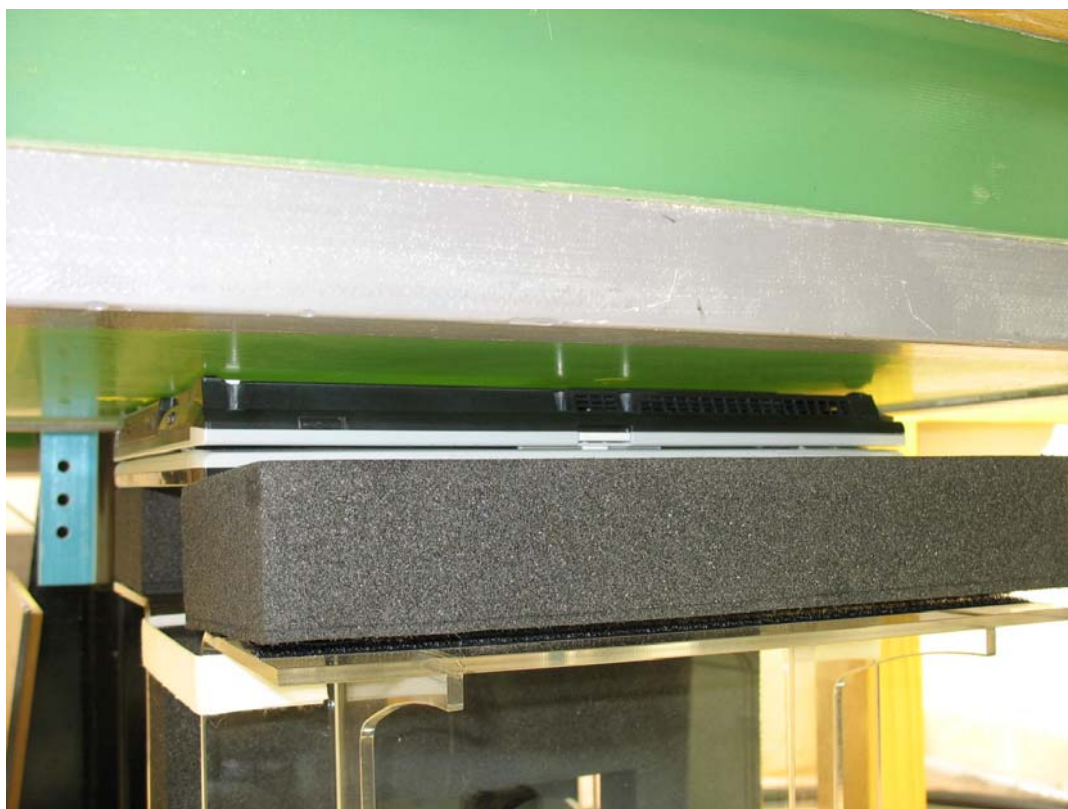
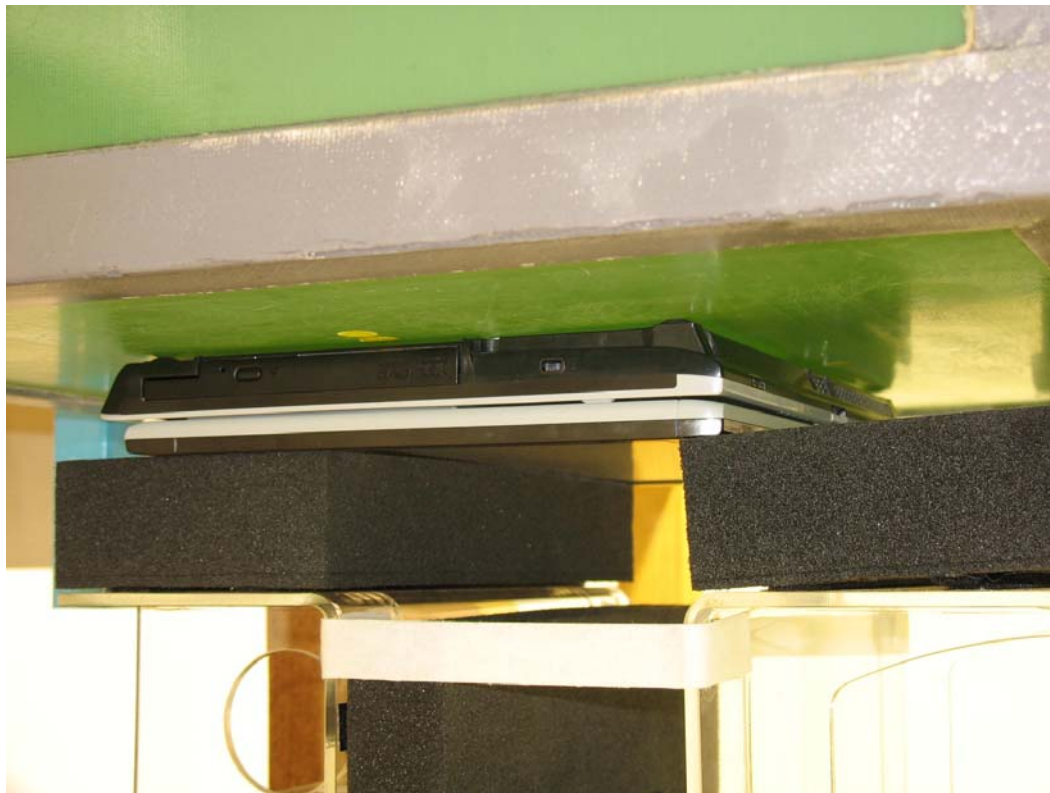


Model: AR5BHB92 (Atheros WLAN Module) inside the Fujitsu Portable Tablet Computer



## APPENDIX A4 TEST SETUP PHOTOGRAPHS

Tablet Position





## APPENDIX A5 TEST SETUP PHOTOGRAPHS

Edge On Position

