

**EMC Technologies Pty Ltd**

A.C.N. 057 105 549

57 Assembly Drive

Tullamarine Victoria Australia 3043

Ph: + 613 9335 3333

Fax: + 613 9338 9260

email: melb@emctech.com.au

SAR Test Report

Report Number: M061026_CERT_AR5BxB6_SAR_2.4G

Test Sample: Portable Notebook Computer Wireless
LAN

Model Number: AR5BxB6

Tested For: Fujitsu Australia Pty Ltd

FCC ID: EJE-WB0045

IC: 337J- WB0045

Date of Issue: 20th October 2006

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CONTENTS

| | | |
|--------------------|---|-----------|
| 1.0 | General Information | 3 |
| 2.0 | Description of Device..... | 4 |
| 2.1 | Description of Test Sample | 4 |
| 2.1.1 | <i>Summary of EUT Details</i> | <i>4</i> |
| 2.1.2 | <i>EUT Host Details</i> | <i>5</i> |
| 2.2 | Test sample Accessories | 5 |
| 2.2.1 | <i>Battery Types</i> | <i>5</i> |
| 2.3 | Test Signal, Frequency and Output Power | 6 |
| 2.4 | Battery Status..... | 7 |
| 2.5 | Details of Test Laboratory | 7 |
| 2.5.1 | <i>Location.....</i> | <i>7</i> |
| 2.5.2 | <i>Accreditations.....</i> | <i>7</i> |
| 2.5.3 | <i>Environmental Factors.....</i> | <i>8</i> |
| 3.0 | DESCRIPTION OF SAR MEASUREMENT SYSTEM | 8 |
| 3.1 | Probe Positioning System | 8 |
| 3.2 | E-Field Probe Type and Performance | 8 |
| 3.3 | Data Acquisition Electronics..... | 8 |
| 3.4 | Calibration and Validation Procedures and Data | 8 |
| 3.4.1 | <i>Validation Results @ 2450MHz</i> | <i>9</i> |
| 3.4.2 | <i>Deviation from reference validation values</i> | <i>9</i> |
| 3.4.3 | <i>Liquid Depth 15cm.....</i> | <i>10</i> |
| 3.5 | Phantom Properties (Size, Shape, Shell Thickness) | 11 |
| 3.6 | Tissue Material Properties..... | 12 |
| 3.6.1 | <i>Liquid Temperature and Humidity.....</i> | <i>12</i> |
| 3.7 | Simulated Tissue Composition Used for SAR Test | 12 |
| 3.8 | Device Holder for Laptops and P 10.1 Phantom | 13 |
| 4.0 | SAR Measurement Procedure Using DASY4 | 13 |
| 5.0 | MEASUREMENT UNCERTAINTY | 14 |
| 6.0 | Equipment List and Calibration Details | 16 |
| 7.0 | OET Bulletin 65 – Supplement C Test Method | 17 |
| 7.1.1 | <i>“Notebook” Position Definition (0mm spacing).....</i> | <i>17</i> |
| 7.2 | List of All Test Cases (Antenna In/Out, Test Frequencies, User Modes) | 18 |
| 7.3 | FCC RF Exposure Limits for Occupational/ Controlled Exposure..... | 18 |
| 7.4 | FCC RF Exposure Limits for Un-controlled/Non-occupational | 18 |
| 8.0 | SAR measurement RESULTS | 19 |
| 8.1 | 2450MHz SAR Results..... | 19 |
| 9.0 | Compliance statement | 20 |
| APPENDIX A1 | Test Sample Photographs | 21 |
| APPENDIX A2 | Test Sample Photographs | 22 |
| APPENDIX A3 | Test Sample Photographs | 23 |
| APPENDIX A4 | Test setup Photographs | 24 |
| APPENDIX B | Plots of the SAR Measurements | 25 |
| APPENDIX C | SAR testing equipment calibration certificate Attachments..... | 40 |

SAR TEST REPORT
Portable Notebook Computer Wireless LAN
Model: AR5BXB6
Report Number: M061026_CERT_AR5BXB6_SAR_2.4G
FCC ID: EJE-WB0045
IC: 337J- WB0045

1.0 GENERAL INFORMATION

Test Sample: Portable Notebook Computer Wireless LAN and Bluetooth Module
Model Name: XB62
Interface Type: Mini-PCI Module
Device Category: Portable Transmitter
Test Device: Production Unit
FCC ID: EJE-WB0045
IC: 337J- WB0045
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 Notebook Computer Wireless LAN model AR5BXB6 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 October 2006

Tested for: Fujitsu Australia Pty Ltd
Address: 1230 Nepean Highway, Cheltenham VIC 3192
Contact: Praveen Rao
Phone: +61 3 9265 0210
Fax: +61 3 9265 0656
E-mail: Praveen.rao@au.fujitsu.com

Test Officer:



Peter Jakubiec
Assoc Dip Elect Eng

Authorised Signature:



Aaron Sargent B.Eng
EMR Engineer

SAR TEST REPORT
Portable Notebook Computer Wireless LAN
Model: AR5BxB6
Report Number: M061026_CERT_AR5BxB6_SAR_2.4G

2.0 DESCRIPTION OF DEVICE

(Information supplied by the client)

2.1 Description of Test Sample

The EUT is a Fujitsu LifeBook P series incorporating a Mini-PCI wireless LAN (WLAN) module XB62 (AR5BxB6). The XB62 module is an OEM product. The Mini-PCI wireless LAN (WLAN) module was tested in the dedicated host, a LifeBook P series "MISTLETOE".

The measurement test results mentioned hereon only apply to the 2450MHz frequency band; an additional report titled "M061026_CERT_AR5BxB6_SAR_5.6G" applies to the 5GHz range.

2.1.1 Summary of EUT Details

Table: EUT Details

| | |
|--------------------------------|---|
| WLAN Module | : XB62 11abg, Model: AR5BxB6 |
| Antenna type | : Monopole Ceramic chip CP313544 (Main:Right), CP313545 (Aux:Left) |
| Applicable Head Configurations | : None |
| Applicable Body Configurations | : Notebook Position |
| Battery Options | : Standard |

Table: Modulation Schemes and Frequency Ranges

| Frequency Range | Modulation | Rated Power Output (dBm) |
|-----------------|--|--------------------------|
| 2.402-2.480 | Bluetooth (BT) Frequency Hopping Spread Spectrum (FHSS) | 12 |
| 2.412-2.462 GHz | 802.11b - DSSS | 17 |
| | 802.11g - OFDM | |
| 5.180-5.320 GHz | 802.11a – OFDM | 16 |
| 5.500-5.700 GHz | | 16 |
| 5.745-5.825 GHz | | 16 |

NOTE: For 5GHz SAR results refer to report titled "M061026_CERT_AR5BxB6_SAR_5.6G".

Table: 802.11a

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

NOTE: For 5GHz SAR results refer to report titled "M061026_CERT_AR5BxB6_SAR_5.6G".

Table: 802.11b

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

Table: 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: Host Details

| | |
|---------------|---|
| Test Sample: | LifeBook P series |
| Model: | P7230 |
| Codename: | MISTLETOE |
| CPU Speed: | Core Duo U2500 1.2GHz |
| Manufacturer: | Fujitsu Ltd. |
| LAN: | Marvell 88E8055 : 10 Base-T/100 Base-TX/1000 Base-T |
| Modem: | Agere MDC1.5 modem Model: D40 |
| LCD Screen: | 10.6" WXGA |

2.2 Test sample Accessories

2.2.1 Battery Types

One type of Fujitsu Lithium Ion Battery is used to power the Portable Notebook Computer Wireless LAN Model: AR5BxB6. SAR measurements were performed with the battery as shown below.

Standard Battery

| | |
|----------|------------|
| Model | W01A-K36AT |
| V | 10.8V |
| Cell No. | 6 |

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 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 2450MHz frequency range. An additional report titled "M061026_CERT_AR5BXB6_SAR_5.6G" 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. Table below shows the data rates used in the SAR tests.

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. 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. The results of this measurement are listed in table below.

Table: Frequency and Conducted Power Results

| Channel | Channel Frequency MHz | Modulation | Maximum Conducted Output Power - Peak Measured (dBm) |
|------------|-----------------------|------------|--|
| Channel 01 | 2412 | DSSS | 17.2 |
| Channel 06 | 2437 | DSSS | 17.3 |
| Channel 11 | 2462 | DSSS | 16.9 |
| Channel 01 | 2412 | OFDM | 16.6 |
| Channel 06 | 2437 | OFDM | 16.5 |
| Channel 11 | 2462 | OFDM | 17.0 |

Table: Frequency and Conducted Power Results Bluetooth

| Channel | Channel Frequency MHz | Modulation | Antenna Port | *Data Rate (Mbps) | Maximum Conducted Output Power Measured (dBm) |
|------------|-----------------------|------------|--------------|-------------------|---|
| Channel 1 | 2402 | FHSS | D | N/A | 3.5 |
| Channel 40 | 2441 | FHSS | D | N/A | 3.7 |
| Channel 79 | 2480 | FHSS | D | N/A | 3.9 |

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 9.5% and was assessed in the uncertainty budget.

2.5 Details of Test Laboratory

2.5.1 Location

EMC Technologies Pty Ltd - ACN/ABN: 82057105549
57 Assembly Drive
Tullamarine, (Melbourne) Victoria
Australia 3043

Telephone: +61 3 9335 3333
Facsimile: +61 3 9338 9260
email: melb@emctech.com.au
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.

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 $21 \pm 1^\circ\text{C}$, the humidity was in the range 43% to 52%. 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.

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 V4.6 Build 23.7** 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.

3.2 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 $\pm 0.25\text{ dB}$. 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.

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 $200\text{ M}\Omega$; 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.

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 2450 MHz with the SPEAG 2450V2 calibrated dipole.

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 known distance from the phantom. The measured SAR is compared to the theoretically derived level.

3.4.1 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 1g (mW/g) | 5. Measured SAR 10g (mW/g) |
|-------------------------|----------------------------|--------------------------------|---------------------------|----------------------------|
| 18 th Oct 06 | 40.0 | 1.76 | 13.5 | 6.35 |

3.4.2 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

| 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 | 13.5 | 54.0 | 55.4 | -4.26 | 52.4 | 3.05 |

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 15cm with a tolerance of 0.5cm.

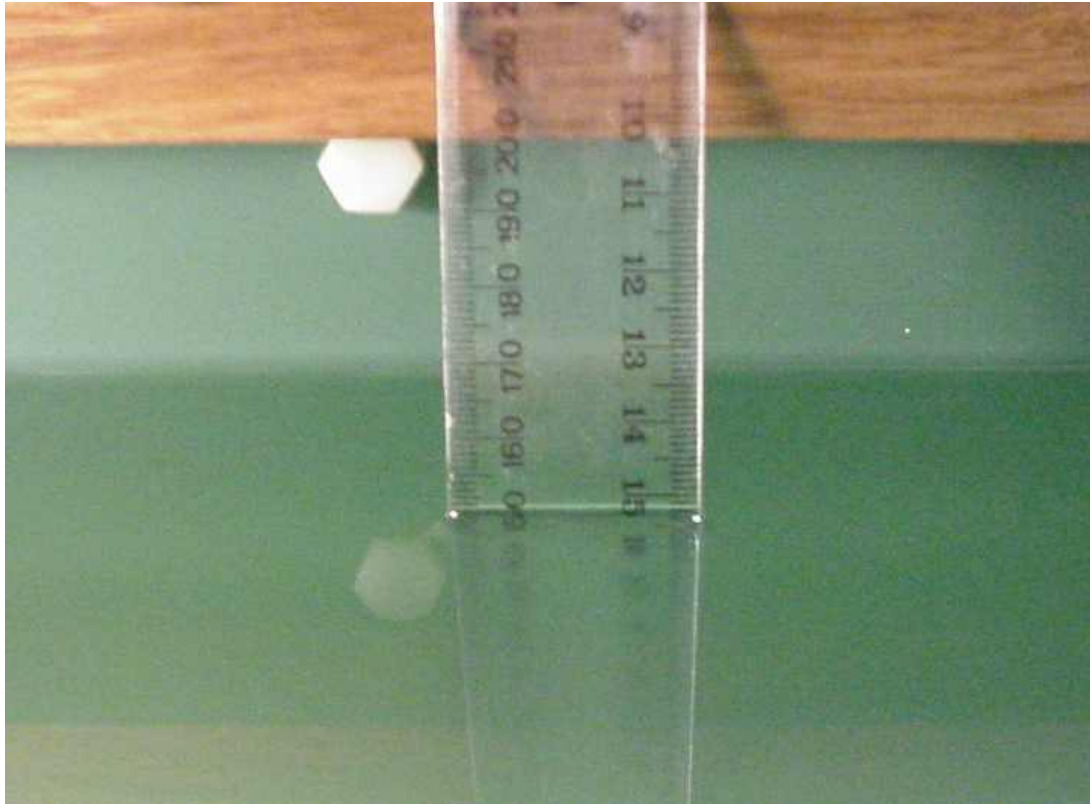


Photo of liquid Depth in Flat Phantom

3.5 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 \pm 0.2 mm and was filled with the required tissue simulating liquid. Below table provides a summary of the measured phantom properties.

Table: Phantom Properties (300MHz-2500MHz)

| Phantom Properties | Required | Measured |
|---------------------------|------------------------------------|---|
| Thickness of flat section | 2.0mm \pm 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 |

P 10.1 Flat Phantom



P 10.1 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: 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 | 40.0 | 39.2 \pm 5% (37.2 to 41.2) | 1.76 | 1.80 \pm 5% (1.71 to 1.89) | 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 | 51.9 | 52.7 \pm 5% (50.1 to 55.3) | 1.87 | 1.95 \pm 5% (1.85 to 2.05) | 1000 |
| 2437 MHz Muscle | 51.8 | 52.7 \pm 5% (50.1 to 55.3) | 1.91 | 1.95 \pm 5% (1.85 to 2.05) | 1000 |
| 2462 MHz Muscle | 51.6 | 52.7 \pm 5% (50.1 to 55.3) | 1.95 | 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%.

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 $|2|^\circ\text{C}$.

Table: Temperature and Humidity recorded for each day

| Date | Ambient Temperature ($^\circ\text{C}$) | Liquid Temperature ($^\circ\text{C}$) | Humidity (%) |
|-------------------------|--|---|--------------|
| 18 th Oct 06 | 21.4 | 21.2 | 52 |

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: 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"

3.8 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

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 101 mm x 81 mm 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 171 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 2.7 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-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: Uncertainty Budget for DASY4 V4.6 Build 23.7 – 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) | 7.2.1 | 4.8 | N | 1 | 1 | 1 | 4.8 | 4.8 | ∞ |
| Axial Isotropy | 7.2.1 | 4.7 | R | 1.73 | 0.707 | 0.707 | 1.9 | 1.9 | ∞ |
| Hemispherical Isotropy | 7.2.1 | 9.6 | R | 1.73 | 0.707 | 0.707 | 3.9 | 3.9 | ∞ |
| Boundary Effect | 7.2.1 | 1 | R | 1.73 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Linearity | 7.2.1 | 4.7 | R | 1.73 | 1 | 1 | 2.7 | 2.7 | ∞ |
| System Detection Limits | 7.2.1 | 1 | R | 1.73 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Readout Electronics | 7.2.1 | 1 | N | 1 | 1 | 1 | 1.0 | 1.0 | ∞ |
| Response Time | 7.2.1 | 0.8 | R | 1.73 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Integration Time | 7.2.1 | 2.6 | R | 1.73 | 1 | 1 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions | 7.2.3 | 0.05 | R | 1.73 | 1 | 1 | 0.0 | 0.0 | ∞ |
| Probe Positioner Mechanical Tolerance | 7.2.2 | 0.4 | R | 1.73 | 1 | 1 | 0.2 | 0.2 | ∞ |
| Probe Positioning with respect to Phantom Shell | 7.2.2 | 2.9 | R | 1.73 | 1 | 1 | 1.7 | 1.7 | ∞ |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | 7.2.4 | 1 | R | 1.73 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Test Sample Related | | | | | | | | | |
| Test Sample Positioning | 7.2.2 | 1.61 | N | 1 | 1 | 1 | 1.6 | 1.6 | 11 |
| Device Holder Uncertainty | | | | | | | | | |
| Output Power Variation – SAR Drift Measurement | 7.2.3 | 10.1 | R | 1.73 | 1 | 1 | 5.8 | 5.8 | ∞ |
| Phantom and Tissue Parameters | | | | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | 7.2.2 | 4 | R | 1.73 | 1 | 1 | 2.3 | 2.3 | ∞ |
| Liquid Conductivity – Deviation from target values | 7.2.3 | 5 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Conductivity – Measurement uncertainty | 7.2.3 | 4.3 | N | 1 | 0.64 | 0.43 | 2.8 | 1.8 | 5 |
| Liquid Permittivity – Deviation from target values | 7.2.3 | 5 | R | 1.73 | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity – Measurement uncertainty | 7.2.3 | 4.3 | N | 1 | 0.6 | 0.49 | 2.6 | 2.1 | 5 |
| Combined standard Uncertainty | | | RSS | | | | 10.9 | 10.5 | 154 |
| Expanded Uncertainty (95% CONFIDENCE LEVEL) | | | k=2 | | | | 21.8 | 20.98 | |

Estimated total measurement uncertainty for the DASY4 measurement system was $\pm 10.9\%$. The extended uncertainty ($K = 2$) was assessed to be $\pm 21.8\%$ based on 95% confidence level. The uncertainty is not added to the measurement result.

Table: Uncertainty Budget for DASY4 V4.6 Build 23.7 – 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.

6.0 EQUIPMENT LIST AND CALIBRATION DETAILS

Table: SPEAG DASY4 Version V4.6 Build 23.7

| 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 | Yes |
| SAM Phantom | SPEAG | N/A | 1060 | Not applicable | No |
| Flat Phantom | AndreT | 10.1 | P 10.1 | Not Applicable | Yes |
| Flat Phantom | AndreT | 9.1 | P 9.1 | Not Applicable | No |
| Flat Phantom | SPEAG | PO1A 6mm | 1003 | Not Applicable | No |
| Data Acquisition Electronics | SPEAG | DAE3 V1 | 359 | 12-July-2007 | No |
| Data Acquisition Electronics | SPEAG | DAE3 V1 | 442 | 08-Dec-2006 | Yes |
| Probe E-Field - Dummy | SPEAG | DP1 | N/A | Not applicable | No |
| Probe E-Field | SPEAG | ET3DV6 | 1380 | 14-Dec-2006 | No |
| Probe E-Field | SPEAG | ET3DV6 | 1377 | 14-July-2007 | Yes |
| Probe E-Field | SPEAG | ES3DV6 | 3029 | Non Compliance | No |
| Probe E-Field | SPEAG | EX3DV4 | 3563 | 14-July-2007 | No |
| Antenna Dipole 300 MHz | SPEAG | D300V2 | 1005 | 26-Oct-2007 | No |
| Antenna Dipole 450 MHz | SPEAG | D450V2 | 1009 | 15-Dec-2006 | No |
| Antenna Dipole 900 MHz | SPEAG | D900V2 | 047 | 6-July-2008 | No |
| Antenna Dipole 1640 MHz | SPEAG | D1640V2 | 314 | 30-June-2008 | No |
| Antenna Dipole 1800 MHz | SPEAG | D1800V2 | 242 | 3-July-2008 | No |
| Antenna Dipole 2450 MHz | SPEAG | D2450V2 | 724 | 2-Nov-2006 | Yes |
| Antenna Dipole 3500 MHz | SPEAG | D3500V2 | 1002 | 1-July-2007 | No |
| Antenna Dipole 5600 MHz | SPEAG | D5GHzV2 | 1008 | 27-Oct-2007 | No |
| RF Amplifier | EIN | 603L | N/A | In test | No |
| RF Amplifier | Mini-Circuits | ZHL-42 | N/A | In test | No |
| RF Amplifier | Mini-Circuits | ZVE-8G | N/A | In test | Yes |
| Synthesized signal generator | Hewlett Packard | ESG-D3000A | GB37420238 | *Not Required | No |
| RF Power Meter Dual | Hewlett Packard | 437B | 3125012786 | 30-May-2007 | Yes |
| RF Power Sensor 0.01 - 18 GHz | Hewlett Packard | 8481H | 1545A01634 | 30-May-2007 | Yes |
| RF Power Meter Dual | Gigatronics | 8542B | 1830125 | 18-April-2007 | Yes |
| RF Power Sensor | Gigatronics | 80301A | 1828805 | 18-April-2007 | Yes |
| RF Power Meter Dual | Hewlett Packard | 435A | 1733A05847 | *Not Required | Yes |
| RF Power Sensor | Hewlett Packard | 8482A | 2349A10114 | *Not Required | Yes |
| Network Analyser | Hewlett Packard | 8714B | GB3510035 | 31-Aug-2007 | No |
| Network Analyser | Hewlett Packard | 8753ES | JP39240130 | 30-Sept-2007 | Yes |
| Dual Directional Coupler | Hewlett Packard | 778D | 1144 04700 | In test | No |
| Dual Directional Coupler | NARDA | 3022 | 75453 | In test | Yes |

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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 LifeBook P series “Mistletoe” can be used in a conventional laptop position (see Appendix A1). The antenna location in the “Mistletoe” 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 technically required in this position.

Therefore SAR measurements were performed with the bottom face of the laptop facing the flat section of the AndreT Flat phantom (P 10.1). See Appendix A for photos of test positions.

7.1.1 “Notebook” 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 “Notebook” position. The Transceiver was placed at the bottom of the phantom and suspended in such way that the bottom of the device was touching the phantom. This device orientation simulates the laptops 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 assessment.

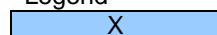
7.2 List of All Test Cases (Antenna In/Out, Test Frequencies, User Modes)

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. The worst-case result was verified with the Bluetooth transmitting at full power in co-transmission with the WLAN.

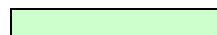
Table: Testing configurations

| Phantom Configuration | *Device Mode | Antenna | Test Configurations | | |
|-----------------------|--------------|---------|---------------------|------------------|----------------|
| | | | Channel (Low) | Channel (Middle) | Channel (High) |
| Notebook Held | OFDM 2.4GHz | A | | X | |
| | | B | | X | |
| | DSSS 2.4GHz | A | | X | |
| | | B | | X | |

Legend



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.

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 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 – DSSS Mode

| 1. Test Position | 2. Plot No. | 3. Antenna | 4. Test Channel | 5. Test Freq (MHz) | 6. Measured 1g SAR Results (mW/g) | 7. Measured Drift (dB) |
|----------------------------|-------------|------------|-----------------|--------------------|-----------------------------------|------------------------|
| *Notebook | 1 | A | 06 | 2437 | Pre-scan Only | - |
| * Notebook | 2 | B | 06 | 2437 | Pre-scan Only | - |
| Notebook | 3 | A | 06 | 2437 | 0.044 | 0.103 |
| | 4 | B | 01 | 2412 | 0.192 | -0.056 |
| | 5 | B | 06 | 2437 | 0.175 | 0.023 |
| | 6 | B | 11 | 2462 | 0.212 | -0.023 |
| Notebook with Bluetooth On | 7 | B | 11 | 2441 | 0.176 | 0.00 |

NOTE: The measurement uncertainty of 21.9% for 2.45GHz was not added to the result.

Table: SAR MEASUREMENT RESULTS – OFDM Mode

| 1. Test Position | 2. Plot No. | 3. Antenna | 4. Test Channel | 5. Test Freq (MHz) | 6. Measured 1g SAR Results (mW/g) | 7. Measured Drift (dB) |
|------------------|-------------|------------|-----------------|--------------------|-----------------------------------|------------------------|
| Notebook | 8 | B | 06 | 2437 | 0.011 | 0.419 |

NOTE: The measurement uncertainty of 21.9% for 2.45GHz was not added to the result.

The highest SAR level recorded in the 2450MHz band was 0.212 mW/g as evaluated in a 1g cube of averaging mass. This value was obtained in Notebook position in DSSS mode, utilizing channel 11 (2462 MHz) and antenna B. The Bluetooth was Off.

9.0 COMPLIANCE STATEMENT

The model AR5BxB6, FCC ID: EJE-WB0045, IC: 337J- WB0045 Portable Notebook Computer Wireless LAN was found to comply with the FCC and RSS-102 SAR requirements.

The highest SAR level recorded was 0.212 mW/g for a 1g cube. This value was measured at 2462 MHz (channel 11) in the "Notebook" position in DSSS modulation mode at the antenna B. The Bluetooth was Off. This was below the limit of 1.6 mW/g for uncontrolled exposure, even taking into account the measurement uncertainty of 21.9 %.

APPENDIX A1 TEST SAMPLE PHOTOGRAPHS

AR5BxB6 Host



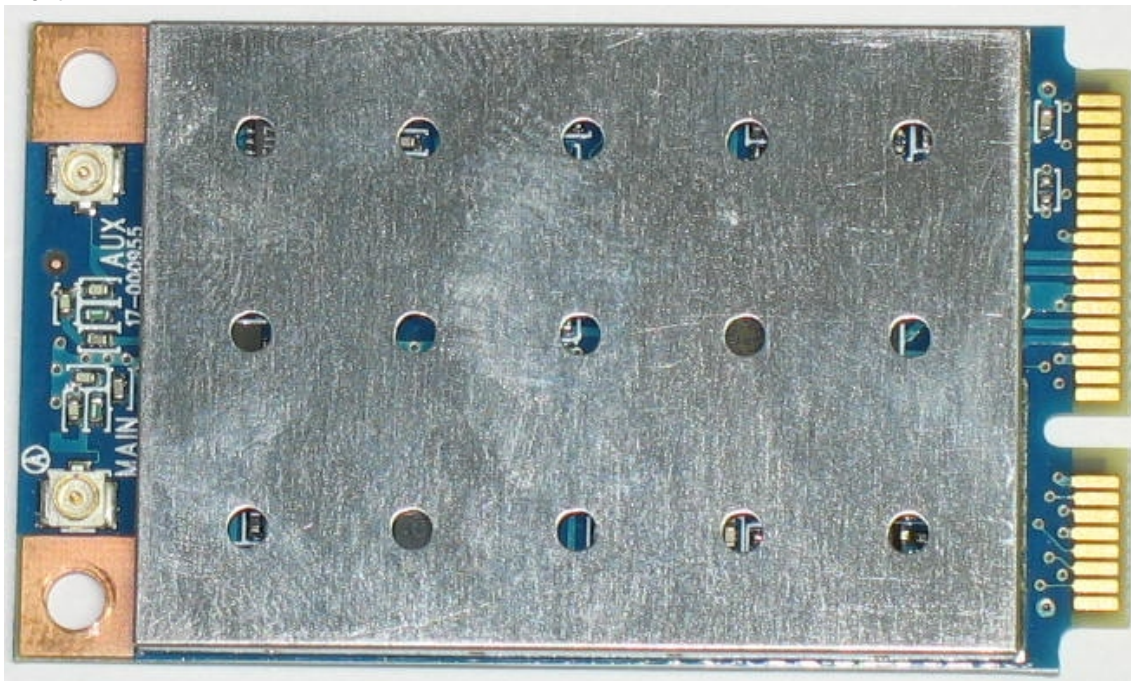
AR5BxB6 Host



APPENDIX A2 TEST SAMPLE PHOTOGRAPHS

Model: AR5BxB6 – WLAN Module

Front



Back



APPENDIX A3 TEST SAMPLE PHOTOGRAPHS

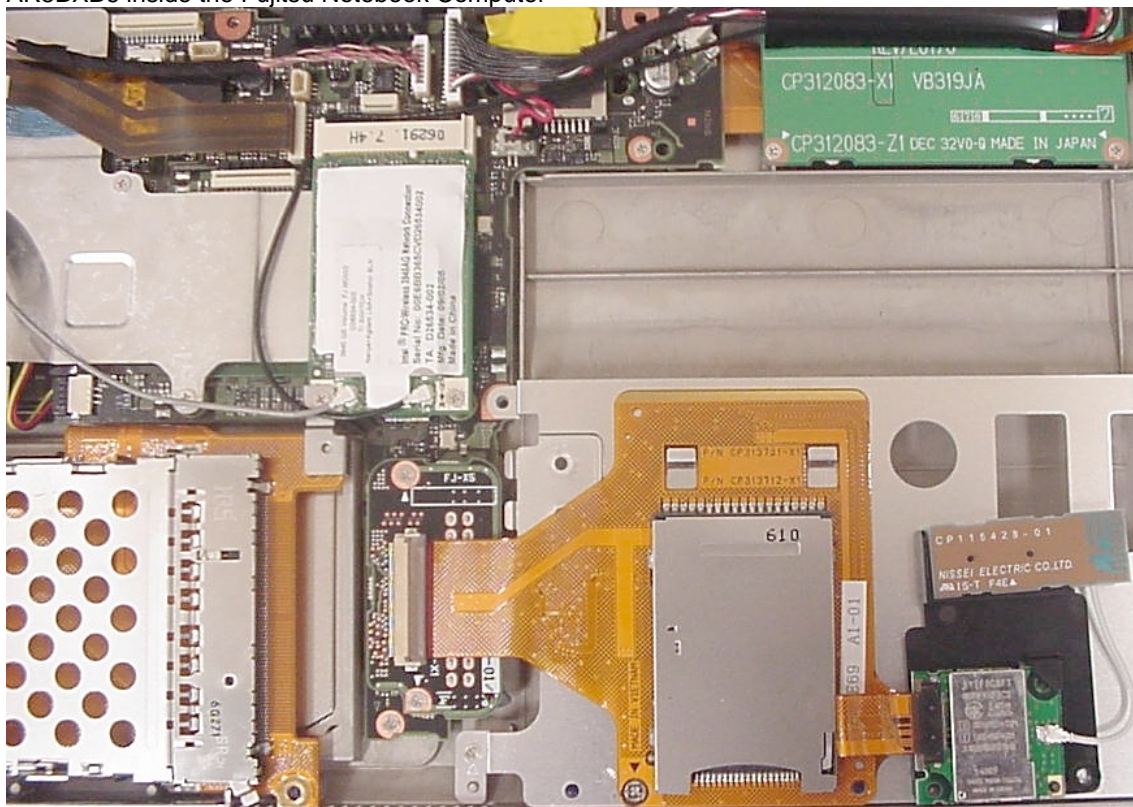
Battery 1



Battery 2



AR5BxB6 inside the Fujitsu Notebook Computer



APPENDIX A4 TEST SETUP PHOTOGRAPHS

Notebook Position

