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EMC-EMF-Safety Approvals

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## SAR Test Report

Report Number: M080644\_CERT\_533AN\_HMW \_SAR\_2.4

Test Sample: Portable TABLET Computer

Radio Modules: WLAN 533AN\_HMW & Bluetooth  
EYTF3CSFS

Host PC Model Number: T2020

PC System FCC ID: EJE-WB0063

PC System IC: 337J-WB0063

Date of Issue: 28<sup>th</sup> August 2008

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Accreditation No. 5292

**SAR TEST REPORT****Report Number: M080644\_CERT\_533AN\_HMW\_SAR\_2.4****PC System FCC ID: EJE-WB0063****PC System IC: 337J-WB0063****1.0 GENERAL INFORMATION**

**Test Sample:** Portable TABLET Computer  
**Model Name:** T2020  
**Radio Modules:** WLAN 533AN\_HMW & Bluetooth EYTF3CSFS  
**Interface Type:** Mini-PCI Module  
**Device Category:** Portable Transmitter  
**Test Device:** Pre-Production Unit  
**PC System FCC ID:** EJE-WB0063  
**PC System IC:** 337J-WB0063  
**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 TABLET Computer T2020 with Wireless LAN model 533AN\_HMW and Bluetooth module EYTF3CSFS 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:** 1<sup>st</sup> July 2008

**Test Officer:**



**Peter Jakubiec**  
**Test Officer**

**Authorised Signature:**



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



**SAR TEST REPORT**  
**Portable TABLET Computer**  
**Model: T2020**  
**Report Number: M080644\_CERT\_533AN\_HMW\_SAR\_2.4**

## 2.0 INTRODUCTION

Specific Absorption Rate (SAR) testing was performed on the Fujitsu TABLET PC, Model: T2020 with INTEL Mini-PCI Wireless LAN Module (WIFI LINK 5300 (SHIRLEY PEAK) 802.11a/b/g/n), Model: 533AN\_HMW & TAIYO YUDEN Bluetooth Module, Model: EYTF3CSFS. The WIFI LINK 5300 (SHIRLEY PEAK) module is an OEM product. The Mini-PCI Wireless LAN (WLAN) was tested in the dedicated host –LifeBook T series, Model T2020.

The measurement test results mentioned hereon only apply to the 2450MHz frequency band; an additional report titled “M080644\_CERT\_533AN\_HMW\_SAR\_5.6” applies to the 5GHz 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>Wireless Module:</b>     | WiFi Link 5300(Shirley Peak) (11a/b/g/n)   |
| <b>Model Number:</b>        | 533AN_HMW  |
| <b>Manufacturer:</b>        | Intel Corporation  |
| <b>Modulation Type:</b>     | DSSS for 802.11b<br>OFDM for 802.11g<br>OFDM for 802.11a<br>OFDM for 802.11n   |
| <b>5GHz (802.11a/n)</b>     | BPSK, QPSK, 16QAM, 64QAM   |
| <b>2.4GHz (802.11b/g/n)</b> | CCK, DQPSK, DBPSK, 16QAM, 64QAM  |
| <b>Maximum Data Rate:</b>   | 802.11b = 11 Mbps, 802.11g and 802.11a = 54 Mbps<br>802.11n = 450 Mbps   |
| <b>Frequency Range:</b>     | 2.412–2.462 GHz for 11b/g/n<br>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<br>24 channels for 11a/n with 20MHz Bandwidth<br>18 channels for 11n with 40MHz Bandwidth  |
| <b>Antenna Types:</b>       | Yokowa Monopole (1 <sup>st</sup> , 2 <sup>nd</sup> ), Nissei Electric Inverted F (3 <sup>rd</sup> )<br>Location: Left Top edge of LCD screen(1 <sup>st</sup> ), Right Top edge of LCD screen(2 <sup>nd</sup> ), Left upper edge of LCD screen (3 <sup>rd</sup> ) |
| <b>Model:</b>               | Tx1 Antenna:CP338043<br>Tx2 Antenna:CP338042<br>Tx3 Antenna:CP313564   |
| <b>Power Supply:</b>        | 3.3 VDC from PCI bus   |



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**Channels and Output power setting:**

| Mode                       | Channel | Frequency, MHz | Data Rate, Mbps | Tx BW, MHz | Average Output Power, dBm |
|----------------------------|---------|----------------|-----------------|------------|---------------------------|
| <b>802.11b<br/>2.4 GHz</b> | 1       | 2412           | 1               | -          | 12.5                      |
|                            | 6       | 2437           |                 |            | 16.5                      |
|                            | 11      | 2462           |                 |            | 11.5                      |
| <b>802.11g<br/>2.4 GHz</b> | 1       | 2412           | 6               | -          | 12.5                      |
|                            | 6       | 2437           |                 |            | 16.5                      |
|                            | 11      | 2462           |                 |            | 11.5                      |
| <b>802.11n<br/>2.4 GHz</b> | 1       | 2412           | HTO             | 20         | 12.5                      |
|                            | 6       | 2437           |                 |            | 16.5                      |
|                            | 11      | 2462           |                 |            | 11.5                      |
|                            | 3       | 2422           |                 | 40 Wide    | 12.5                      |
|                            | 6       | 2437           |                 |            | 16.5                      |
|                            | 9       | 2452           |                 |            | 13.5                      |

NOTE: For 5GHz SAR results refer to report titled "M080644\_CERT\_533AN\_HMW\_SAR\_5.6".

**3.2 EUT (Bluetooth) Details**

**Transmitter:** Bluetooth  
**Model Number:** EYTF3CS FS  
**Manufacturer:** TAIYO YUDEN  
**Network Standard:** Bluetooth™ RF Test Specification  
**Modulation Type:** Frequency Hopping Spread Spectrum (FHSS)  
**Frequency Range:** 2402 MHz to 2480 MHz  
**Number of Channels:** 79  
**Carrier Spacing:** 1.0 MHz  
**Antenna Types:** Antenna : CP331590  
Location: Right palm rest area  
**Antenna gain:** Please refer antenna data provided separately  
**Max. Output Power:** 4 dBm  
**Reference Oscillator:** 16 MHz (Built-in)  
**Power Supply:** 3.3 VDC from host.

**Frequency allocation:**

| Channel Number | Frequency (MHz) | Bluetooth Utility power setting |
|----------------|-----------------|---------------------------------|
| 1*             | 2402            | Power (Ext, Int) = 0, 96        |
| 2              | 2403            |                                 |
| 3              | 2404            |                                 |
| .              | .               |                                 |
| .              | .               |                                 |
| 39             | 2440            |                                 |
| 40*            | 2441            |                                 |
| 41             | 2442            |                                 |
| .              | .               |                                 |
| .              | .               |                                 |
| 77             | 2478            |                                 |
| 78             | 2479            |                                 |
| 79*            | 2480            |                                 |

\*Channels tested



### 3.3 EUT (Notebook PC) Details

|                               |  |
|-------------------------------|--|
| <b>EUT:</b>                   | LIFEBOOK T SERIES                                  |
| <b>Model Name:</b>            | T2020  |
| <b>Serial Number:</b>         | Pre-production Sample                              |
| <b>Manufacturer:</b>          | FUJITSU LIMITED                                    |
| <b>CPU Type and Speed:</b>    | Core2 Duo SU9400 1.4GHz                            |
| <b>LCD</b>                    | 12.1" WXGA   |
| <b>Wired LAN:</b>             | Marvell 88E8057 : 10 Base-T/100 Base-TX/1000Base-T |
| <b>Modem:</b>                 | Agere MDC1.5 modem Model: D40                      |
| <b>Port Replicator Model:</b> | FPCPR87  |
| <b>AC Adapter Model:</b>      | 60W: SED80N2-16.0(Sanken)                          |
| <b>Voltage:</b>               | 16V  |
| <b>Current Specs:</b>         | 3.75A  |
| <b>Watts:</b>                 | 60W  |

### 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 with Wireless LAN Model: 533AN\_HMW. SAR measurements were performed with the battery as shown below.

#### Standard Battery

##### Battery #1

|       |               |
|-------|---------------|
| Model | FPCBP186      |
| V/mAh | 10.8V/5800mAh |

##### Battery #2

|       |                          |
|-------|--------------------------|
| Model | NCR-B/608AE,<br>Chaplain |
| V/mAh | 10.8V/5800mAh            |



## 4.0 TEST SIGNAL, FREQUENCY AND OUTPUT POWER

INTEL's CRTU test tool was used to configure the WLAN for testing. The Portable Tablet Computer Wireless LAN had a total of 11 channels 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 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 only the Bluetooth module operating for the purpose of determining co-transmission requirements.

The test results mentioned in this report only apply to the 2450MHz frequency range. An additional report titled "M080644\_CERT\_533AN\_HMW\_SAR\_5.6" is specific to the 5GHz range.

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

The frequency span of the 2450 MHz range Band was more than 10MHz consequently; the SAR levels of the test sample were measured for lowest, centre and highest channels in the applicable modes. 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, 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 Transmitter power was set to be equal or higher than power specified by the manufacturer.

### 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.



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## 5.0 DETAILS OF TEST LABORATORY

### 5.1 Location

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Australia 3042

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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:

|                        |  |
|------------------------|--|
| <b>AS/NZS 2772.1:</b>  | RF and microwave radiation hazard measurement  |
| <b>ACA:</b>            | Radio communications (Electromagnetic Radiation - Human Exposure) Standard 2003  |
| <b>FCC:</b>            | Guidelines for Human Exposure to RF Electromagnetic Field OET65C 01/01   |
| <b>EN 50360: 2001</b>  | Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)              |
| <b>EN 50361: 2001</b>  | Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300MHz – 3GHz)                          |
| <b>IEEE 1528: 2003</b> | 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](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  $20 \pm 1^\circ\text{C}$ , the humidity was 41%. 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  $5\mu\text{V}$  in both air and liquid mediums.





## 6.0 DESCRIPTION OF SAR MEASUREMENT SYSTEM

|                                |                    |
|--------------------------------|--------------------|
| Applicable Head Configurations | : None             |
| Applicable Body Configurations | : Tablet Position  |
|                                | : Edge On 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  $\pm 0.02$  mm. The DASY4 fully complies with the OET65 C (01-01), IEEE 1528 and EN50361 SAR measurement requirements.

### 6.2 E-Field Probe Type and Performance

The SAR measurements were conducted with SPEAG dosimetric probe ET3DV6 Serial: 1380 (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  $\pm 0.25$  dB. The probe is suitable for measurements close to material discontinuity at the surface of the phantom. The sensors of the probe are directly loaded with Schottky diodes and connected via highly resistive lines (length = 300 mm) to the data acquisition unit.

### 6.3 Data Acquisition Electronics

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. The input impedance of the DAE3 box is 200 M $\Omega$ ; 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 @ 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. $\epsilon_r$ (measured) | 3. $\sigma$ (mho/m) (measured) | 4. Measured SAR 1g (mW/g) | 5. Measured SAR 10g (mW/g) |
|---------------------------|----------------------------|--------------------------------|---------------------------|----------------------------|
| 1 <sup>st</sup> July 2008 | 39.7                       | 1.8                            | 13.9                      | 6.55                       |



#### 6.4.2 Deviation from reference validation values

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

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

**Table: Deviation from reference validation values @ 2450MHz**

| Frequency and Date                   | Measured SAR 1g (mW/g) | Measured SAR 1g (Normalized to 1W) | SPEAG Calibration reference SAR Value 1g (mW/g) | Deviation From SPEAG Reference (1g) | IEEE Std 1528 reference SAR value 1g (mW/g) | Deviation From IEEE (1g) |
|--------------------------------------|------------------------|------------------------------------|---|-------------------------------------|---|--------------------------|
| 1 <sup>st</sup> July 2008<br>2450MHz | 13.9                   | 55.60                              | 53.3  | 4.32                                | 52.4  | 6.11                     |

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

#### 6.4.3 Liquid Depth 15cm

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

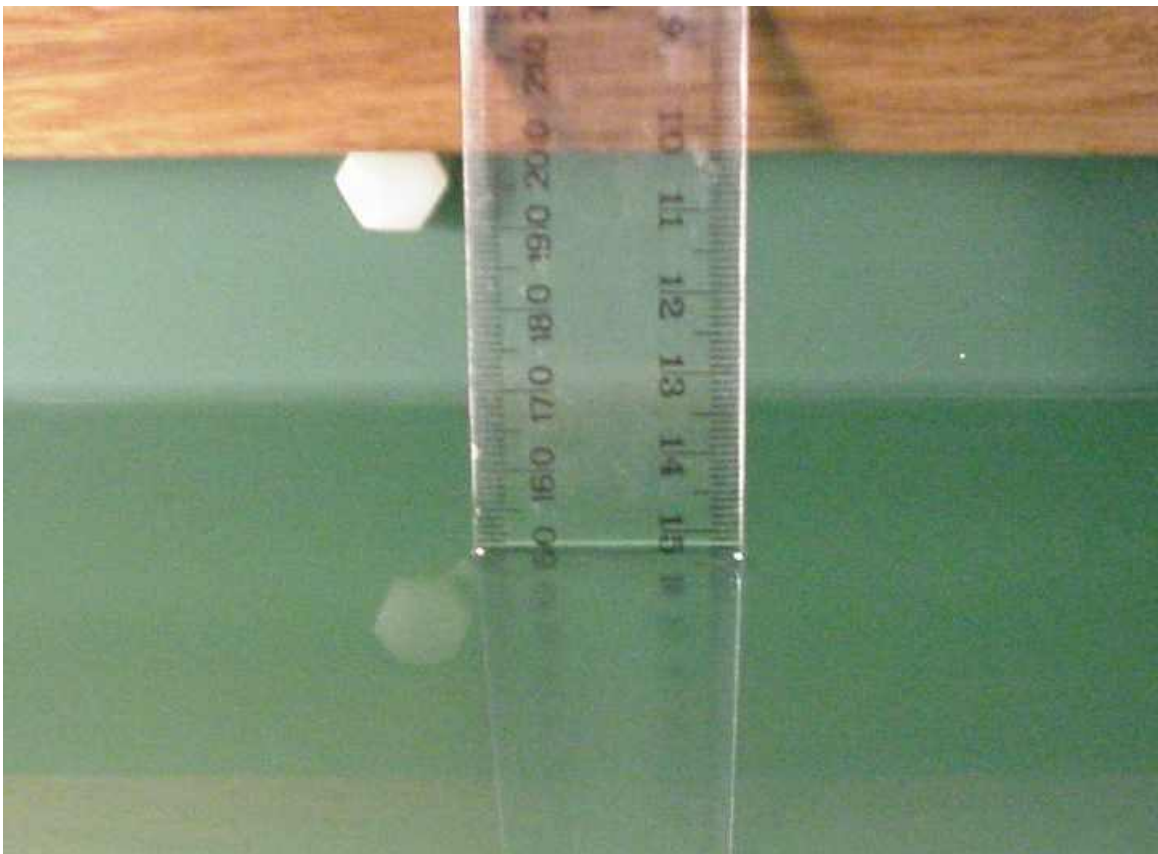


Photo of liquid Depth in Flat Phantom

## 6.5 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. Below table provides a summary of the measured phantom properties.

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

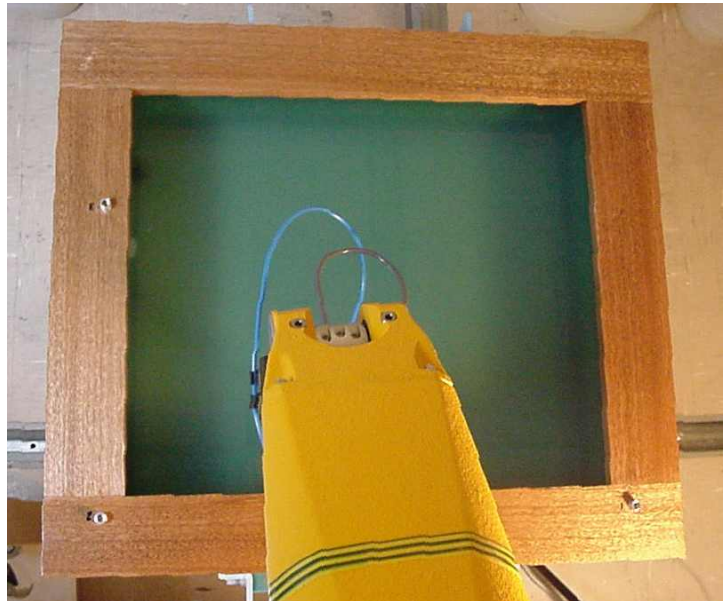
| Phantom Properties        | Required                           | Measured                                |
|---------------------------|------------------------------------|---|
| Thickness of flat section | 2.0mm $\pm$ 0.2mm (bottom section) | 2.12-2.20mm                             |
| Dielectric 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



## 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    | $\epsilon_r$<br>(measured range) | $\epsilon_r$<br>(target)        | $\sigma$ (mho/m)<br>(measured range) | $\sigma$<br>(target)            | $\rho$<br>kg/m <sup>3</sup> |
|-------------------|----------------------------------|---------------------------------|--------------------------------------|---------------------------------|-----------------------------|
| 2450 MHz<br>Brain | 39.7                             | 39.2 $\pm$ 5%<br>(37.2 to 41.2) | 1.80                                 | 1.80 $\pm$ 5%<br>(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     | $\epsilon_r$<br>(measured range) | $\epsilon_r$<br>(target)        | $\sigma$ (mho/m)<br>(measured range) | $\sigma$<br>(target)            | $\rho$<br>kg/m <sup>3</sup> |
|--------------------|----------------------------------|---------------------------------|--------------------------------------|---------------------------------|-----------------------------|
| 2412 MHz<br>Muscle | 51.2                             | 52.7 $\pm$ 5%<br>(50.1 to 55.3) | 1.87                                 | 1.95 $\pm$ 5%<br>(1.85 to 2.05) | 1000                        |
| 2437 MHz<br>Muscle | 51.1                             | 52.7 $\pm$ 5%<br>(50.1 to 55.3) | 1.91                                 | 1.95 $\pm$ 5%<br>(1.85 to 2.05) | 1000                        |
| 2462 MHz<br>Muscle | 50.9                             | 52.7 $\pm$ 5%<br>(50.1 to 55.3) | 1.95                                 | 1.95 $\pm$ 5%<br>(1.85 to 2.05) | 1000                        |

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

### 6.6.1 Liquid Temperature and Humidity

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

**Table: Temperature and Humidity recorded for each day**

| Date                      | Ambient Temperature ( $^\circ\text{C}$ ) | Liquid Temperature ( $^\circ\text{C}$ ) | Humidity (%) |
|---------------------------|--|---|--------------|
| 1 <sup>st</sup> July 2008 | 20.2                                     | 19.9                                    | 41           |

## 6.7 Simulated Tissue Composition Used for SAR Test

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

**Table: Tissue Type: Brain @ 2450MHz**

Volume of Liquid: 30 Litres

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

**Table: Tissue Type: Muscle @ 2450MHz**

Volume of Liquid: 60 Litres

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

\*Refer "OET Bulletin 65 97/01 P38"



## 6.8 Device Holder for Laptops and P 10.1 Phantom

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

*Refer to Appendix A for photographs of device positioning*

## 7.0 SAR MEASUREMENT PROCEDURE USING DASY4

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

- a) A measurement of the SAR value at a fixed location is used as a reference value for assessing the power drop of the EUT. The SAR at this point is measured at the start of the test, and then again at the end of the test.
- b) The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 3.9 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 15 mm x 15 mm. The actual Area Scan has dimensions of 120 mm x 150 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 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.





## 8.0 MEASUREMENT UNCERTAINTY

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

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

| a   | b     | c           | d              | e=<br>f(d,k) | f                   | g                    | h=cxf/e               | i=cxg/e                | k              |
|---|-------|-------------|----------------|--------------|---------------------|----------------------|-----------------------|------------------------|----------------|
| Uncertainty Component   | Sec.  | Tol.<br>(%) | Prob.<br>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) (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                    | ∞              |
| <b>Test Sample Related</b>  |       |             |                |              |                     |                      |                       |                        |                |
| Test Sample Positioning   | 7.2.2 | 1.61        | N              | 1            | 1                   | 1                    | 1.6                   | 1.6                    | 11             |
| Device Holder Uncertainty   | E.4.1 | 3.34        | N              | 1            | 1                   | 1                    | 3.3                   | 3.3                    | 7              |
| Output Power Variation – SAR Drift Measurement                                  | 7.2.3 | 11.81       | R              | 1.73         | 1                   | 1                    | 6.8                   | 6.8                    | ∞              |
| <b>Phantom and Tissue Parameters</b>  |       |             |                |              |                     |                      |                       |                        |                |
| 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            |              |                     |                      | <b>12.0</b>           | <b>11.6</b>            | 154            |
| Expanded Uncertainty (95% CONFIDENCE LEVEL)                                     |       |             | k=2            |              |                     |                      | <b>23.9</b>           | <b>23.13</b>           |                |

Estimated total measurement uncertainty for the DASY4 measurement system was  $\pm 12.0\%$ . The extended uncertainty ( $K = 2$ ) was assessed to be  $\pm 23.9\%$  based on 95% confidence level. The uncertainty is not added to the measurement result.



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

| a   | b     | c            | D              | e=<br>f(d,k) | f                   | g                    | h=cxf/e                   | i=cxg/e                    | k              |
|---|-------|--------------|----------------|--------------|---------------------|----------------------|---------------------------|----------------------------|----------------|
| Uncertainty Component   | Sec.  | Tol.<br>(6%) | Prob.<br>Dist. | Div.         | C <sub>i</sub> (1g) | C <sub>i</sub> (10g) | 1g u <sub>i</sub><br>(6%) | 10g u <sub>i</sub><br>(6%) | v <sub>i</sub> |
| <b>Measurement System</b>   |       |              |                |              |                     |                      |                           |                            |                |
| 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                        | ∞              |
| <b>Test Sample Related</b>  |       |              |                | □            |                     |                      |                           |                            |                |
| 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                        | ∞              |
|   |       |              |                | □            |                     |                      |                           |                            | □              |
| <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         | 0.6                 | 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            |              |                     |                      | <b>8.0</b>                | <b>7.8</b>                 | 154            |
| Expanded Uncertainty (95% CONFIDENCE LEVEL)                                     |       |              | k=2            |              |                     |                      | 16.0                      | 15.63                      |                |

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



## 9.0 EQUIPMENT LIST AND CALIBRATION DETAILS

**Table: SPEAG DASY4 Version V4.7 Build 53**

| Equipment Type                | Manufacturer    | Model Number | Serial Number | Calibration Due | Used For this Test? |
|-------------------------------|-----------------|--------------|---------------|-----------------|---------------------|
| Robot - Six Axes              | Staubli         | RX90BL       | N/A           | Not applicable  | ✓                   |
| Robot Remote Control          | SPEAG           | CS7MB        | RX90B         | Not applicable  | ✓                   |
| SAM Phantom                   | SPEAG           | N/A          | 1260          | Not applicable  | ✓                   |
| SAM Phantom                   | SPEAG           | N/A          | 1060          | Not applicable  |                     |
| Flat Phantom                  | AndreT          | 10.1         | P 10.1        | Not Applicable  | ✓                   |
| Flat Phantom                  | AndreT          | 9.1          | P 9.1         | Not Applicable  |                     |
| Flat Phantom                  | SPEAG           | PO1A 6mm     | 1003          | Not Applicable  |                     |
| Data Acquisition Electronics  | SPEAG           | DAE3 V1      | 359           | 11-July-2009    |                     |
| Data Acquisition Electronics  | SPEAG           | DAE3 V1      | 442           | 24-July-2009    | ✓                   |
| 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          | 14-July-2009    |                     |
| Probe E-Field                 | SPEAG           | ES3DV6       | 3029          | Not Used        |                     |
| Probe E-Field                 | SPEAG           | EX3DV4       | 3563          | 14-July-2009    |                     |
| 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           | 7-July-2010     |                     |
| Antenna Dipole 1640 MHz       | SPEAG           | D1640V2      | 314           | 16-July-2010    |                     |
| Antenna Dipole 1800 MHz       | SPEAG           | D1800V2      | 242           | 8-July-2010     |                     |
| Antenna Dipole 1950 MHz       | SPEAG           | D1950V3      | 1113          | 5-March-2009    |                     |
| Antenna Dipole 3500 MHz       | SPEAG           | D3500V2      | 1002          | 06-July-2009    |                     |
| 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           | *In test        |                     |
| RF Amplifier                  | Mini-Circuits   | ZHL-42       | N/A           | *In test        |                     |
| RF Amplifier                  | Mini-Circuits   | ZVE-8G       | N/A           | *In test        | ✓                   |
| Synthesized signal generator  | Hewlett Packard | ESG-D3000A   | GB37420238    | *In test        | ✓                   |
| RF Power Meter Dual           | Hewlett Packard | 437B         | 3125012786    | 07-July-2009    | ✓                   |
| RF Power Sensor 0.01 - 18 GHz | Hewlett Packard | 8481H        | 1545A01634    | 09-July-2009    | ✓                   |
| RF Power Meter Dual           | Gigatronics     | 8542B        | 1830125       | 24-June-2009    | ✓                   |
| RF Power Sensor               | Gigatronics     | 80301A       | 1828805       | 24-June-2009    | ✓                   |
| 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.

### 10.1 Positions

#### 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” 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. The bluetooth was measured operating at full power for all applicable positions.

**Table: Testing configurations**

| Phantom Configuration | *Device Mode     | Antenna | Test Configurations |                  |                |
|-----------------------|------------------|---------|---------------------|------------------|----------------|
|                       |                  |         | Channel (Low)       | Channel (Middle) | Channel (High) |
| Tablet                | DSSS (WiFi only) | A       |                     | X                |                |
|                       |                  | B       |                     | X                |                |
|                       |                  | C       |                     | X                |                |
|                       | FHSS (BT only)   | -       |                     | X                |                |
| Edge On Left          | DSSS (WiFi only) | A       |                     | X                |                |
|                       |                  | B       |                     | X                |                |
|                       |                  | C       |                     | X                |                |
|                       | FHSS (BT only)   | -       |                     | X                |                |
| Edge On Right         | DSSS (WiFi only) | A       |                     | X                |                |
|                       |                  | B       |                     | X                |                |
|                       |                  | C       |                     | X                |                |

#### 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 2450MHz SAR Results**

There are two modes of operation within the 2450 MHz band, they include OFDM and DSSS modulations. Refer to section 10.2 for selection of all device test configurations. Table below displays the SAR results.

**Table: SAR MEASUREMENT RESULTS – DSSS Mode (Bluetooth OFF)**

| 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        | A   | 1                    | -                       | 6            | 2437            | 0.07                           | -0.021              |
| Tablet        | 2        | B   | 1                    | -                       | 6            | 2437            | 0.04                           | -0.273              |
|               | 3        | C   | 1                    | -                       | 6            | 2437            | 0.03                           | 0.080               |
| Edge On Left  | 4        | B   | 1                    | -                       | 6            | 2437            | 0.07                           | -0.243              |
|               | 5        | C   | 1                    | -                       | 6            | 2437            | 0.15                           | -0.485              |
| Edge On Right | 6        | A   | 1                    | -                       | 1            | 2412            | 0.15                           | -0.395              |
|               | 7        | A   | 1                    | -                       | 6            | 2437            | 0.16                           | -0.202              |
|               | 8        | A   | 1                    | -                       | 11           | 2462            | 0.17                           | -0.144              |

NOTE: The measurement uncertainty of 23.9% for 2.45GHz was not added to the result.

**Table: SAR MEASUREMENT RESULTS – Bluetooth Mode (WiFi OFF)**

| Test Position | Plot No. | Test Channel | Test Freq (MHz) | Measured 1g SAR Results (mW/g) | Measured Drift (dB) |
|---------------|----------|--------------|-----------------|--------------------------------|---------------------|
| Tablet        | -        | 40           | 2441            | N/F                            | N/A                 |
| Edge On Left  | -        | 40           | 2441            | N/F                            | N/A                 |

NOTE: The measurement uncertainty of 23.9% for 2.45GHz was not added to the result.

The highest SAR level recorded in the 2450MHz band was 0.17 mW/g as evaluated in a 1g cube of averaging mass. This value was obtained in Edge on Right position in DSSS mode, utilizing channel 11 (2462 MHz) and antenna A. The Bluetooth was OFF at the Frequency of 2441 MHz.



## 12.0 COMPLIANCE STATEMENT

The Fujitsu TABLET PC, Model: T2020 with INTEL Mini-PCI Wireless LAN Module (WIFI LINK 5300 (SHIRLEY PEAK) 802.11a/b/g/n), Model: 533AN\_HMW & TAIYO YUDEN Bluetooth Module, Model: EYTF3CSFS was found to comply with the FCC and RSS-102 SAR requirements.

The highest SAR level recorded was 0.17 mW/g for a 1g cube. This value was measured at 2462 MHz (channel 11) in the “Edge on Right” position in DSSS modulation mode at the antenna A. This was below the limit of 1.6 mW/g for uncontrolled exposure, even taking into account the measurement uncertainty of 23.9%.



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## APPENDIX A1 TEST SETUP PHOTOGRAPHS

Tablet Position



Edge On Right Position





Edge On Left Position

