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**EMI TEST REPORT FOR CERTIFICATION  
to  
FCC PART 15 Subpart E (Section 15.407) & RSS-210**

FCC ID: EJE-WB0030  
Industry Canada ID: 337J-WB0030

Test Sample: LifeBook "C" Series  
Model: C1320

Radio Modules: Mini-PCI WLAN (Calexico2 11a+b/g), Model:  
WM3B2915ABG & Bluetooth, Model UGXZ5-102A

Report Number M050533\_Cert\_WM3B2915ABG\_11abg\_NII\_BT

Tested for: Fujitsu Australia Ltd.

Issue Date: 3<sup>rd</sup> June 2005

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NATA Accredited Laboratory  
Number: 5292

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**CONTENTS**

- 1.0 INTRODUCTION**
- 2.0 GENERAL INFORMATION**

**RESULTS – WLAN, WM3B2915ABG (802.11a of Callexico2 11a+b/g)\***

- 3.0 CONDUCTED EMI MEASUREMENTS**
- 4.0 RADIATED EMI MEASUREMENTS**
- 5.0 PEAK OUTPUT POWER**
- 6.0 CHANNEL BANDWIDTH**
- 7.0 RADIO FREQUENCY EXPOSURE**
- 8.0 PEAK POWER SPECTRAL DENSITY**
- 9.0 PEAK EXCURSION**
- 10.0 FREQUENCY STABILITY**
- 11.0 ANTENNA REQUIREMENT**
- 12.0 COMPLIANCE STATEMENT**

**\*RESULTS of 802.11b/g and 802.11a (5725 – 5850 MHz):**

**Refer to Report No: M050533\_Cert\_WM3B2915ABG\_11abg\_DTS\_BT**

**RESULTS – Bluetooth, UGXZ5-102A**

**Refer to Report No: M050533\_Cert\_BT\_WM3B2915ABG\_11abg**

- APPENDIX A: MEASUREMENT INSTRUMENTATION DETAILS**
- APPENDIX B: REPORT PHOTOGRAPHS**
- APPENDIX C: FUNCTIONAL DESCRIPTION**
- APPENDIX D: BLOCK DIAGRAM**
- APPENDIX E: SCHEMATICS**
- APPENDIX F: ANTENNA INFORMATION**
- APPENDIX G: FCC LABELLING DETAILS**
- APPENDIX H: USER MANUAL**
- APPENDIX I: CHANNEL BANDWIDTH PLOTS**
- APPENDIX J: HARMONICS PLOTS**
- APPENDIX K: BANDEDGE PLOTS**
- APPENDIX L: PEAK POWER SPECTRAL DENSITY PLOTS**
- APPENDIX M: PEAK EXCURSION PLOTS**

**Attachment 1: RF Exposure Information**

**Attachment 2: FCC DOC for LifeBook “C” Series**

**Attachment 3: FCC Part 15B Test Report (Report: FG05-053EAL)**



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**EMI TEST REPORT FOR CERTIFICATION**  
**to**  
**FCC PART 15 Subpart E (Section 15.407) & RSS-210**

**Report Number:** M050533\_Cert\_WM3B2915ABG\_11abg\_NII\_BT

**Test Sample:** LifeBook "C" Series  
**Model:** C1320  
**Radio Modules:** Mini-PCI WLAN, Model: WM3B2915ABG (Intel Corp.)  
Bluetooth, Model: UGXZ5-102A (Fujitsu Ltd)

**FCC ID:** EJE-WB0030  
**Industry Canada ID:** 337J-WB0030  
**Equipment Type:** Intentional Radiator (Transceiver)

**Manufacturer (LifeBook):** Fujitsu Ltd  
**Address:** 1405, Ohamaru, Inagi-shi, Tokyo 206-8503, Japan  
**Contact:** Mr. Tsuyoshi Uchihara


**Tested for:** Fujitsu Australia Ltd

**Test Standards:** FCC Part 15, Subpart E – Unlicensed National Information, Infrastructure Devices  
FCC Part 15.407, General Technical Requirements  
ANSI C63.4 – 2003  
OET Bulletin No. 65  
  
RSS-210 Issue 5 Low Power Licence-Exempt RadioCommunication Devices:  
6.2.2 (q1) 5150 - 5350 MHz & 5725-5825 MHz Local Area Network Devices  
  
RSS-102 Issue 1 (Provisional), 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

**Test Dates:** 24<sup>th</sup> – 30<sup>th</sup> May 2005

**Test Officers:**   
**Chieu Huynh - B.Eng (Hons) Electronics**  
**Jorge Lara**

**Attestation:** *I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*

**Authorised Signatory:**   
**Chris Zombolas**  
**Technical Director**  
**EMC Technologies Pty Ltd**



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## EMI TEST REPORT FOR CERTIFICATION to FCC PART 15 Subpart E (Section 15.407) & RSS-210

### 1.0 INTRODUCTION

EMI testing was performed on test sample LifeBook "C" Series, Model: C1320 with Mini-PCI Wireless LAN Module (Calexico2 11a+b/g), Model WM3B2915ABG & Bluetooth, Model UGXZ5-102A.

The Calexico2 WLAN supports IEEE 802.11b, IEEE 802.11g and IEEE802.11a (DTS & U-NII) configurations. Tests were performed in all three configurations and also on the Bluetooth.

The results for configurations IEEE 802.11a (U-NII: 5150 – 5350 MHz) are reported in this test report.

The results for configurations IEEE 802.11b, IEEE 802.11g and IEEE802.11a (DTS: 5725 – 5850 MHz) and Bluetooth are reported separately.

Refer to EMC Technologies' test report: M050533\_Cert\_WM3B2915ABG\_11abg\_DTS\_BT (DTS) and M050533\_Cert\_BT\_WM3B2915ABG\_11abg (Bluetooth).

Test results and procedures were performed in accordance with the following Federal Communications Commission (FCC) standards/regulations:

|                             |   |
|-----------------------------|---|
| 47 CFR, Part 15, Subpart E: | Unlicensed National Information Infrastructure Devices (U-NII) operating in the 5.15-5.35 GHz and 5.725-5.825 GHz frequency bands |
| Section 15.203:             | Antenna requirements  |
| Section 15.205:             | Restricted bands of operation   |
| Section 15.207:             | Conducted Emission Limits   |
| Section 15.209:             | Radiated Emission Limits (General requirements)   |
| Section 15.407:             | General Technical Requirements  |

The results and technical details of the test sample are detailed in this report. The test sample **complies** with the requirements of 47 CFR, Part 15 Subpart E - Section 15.407.

The test sample also complies with the Industry Canada RSS-210 issue 5 (Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)) clause 6.2.2(q1) requirements and the RF exposure requirements of RSS-102.



## 1.1 Summary of Results

### 1.1.1 WLAN, Calexico2 802.11a (U-NII) - FCC Subpart E, Section 15.407

| FCC Part 15, Subpart E Clauses | Industry Canada RSS-210 Clauses | Test Performed               | Result         |
|--------------------------------|---------------------------------|------------------------------|----------------|
| 15.203                         | 5.5                             | Antenna Requirement          | Not Applicable |
| 15.205                         | 6.3                             | Operation in Restricted Band | Complies       |
| 15.207                         | 6.6                             | Conducted Emissions          | Complies       |
| 15.209                         | 6.3                             | Radiated Emissions           | Complies       |
| 15.407 (a)(4)                  | 6.2.2(q1)                       | Peak Transmit Power          | Complies       |
| 15.407 (a)(5)                  | 6.2.2(q1)                       | Peak Power Spectral Density  | Complies       |
| 15.407 (a)(6)                  |                                 | Peak Excursion               | Complies       |
| 15.407 (b)                     | 6.2.2(q1)                       | Undesirable Emission         | Complies       |
| 15.407 (f)                     |                                 | Radio Frequency Hazard       | Complies       |
| 15.407 (g)                     | 6.4                             | Frequency Stability          | Complies       |

### 1.1.2 WLAN, Calexico2 802.11b, 802.11g and 802.11a (DTS) - FCC Subpart C, Section 15.247

| FCC Part 15, Subpart C Clauses | Industry Canada RSS-210 Clauses | Test Performed               | Result         |
|--------------------------------|---------------------------------|------------------------------|----------------|
| 15.203                         | 5.5                             | Antenna Requirement          | Not Applicable |
| 15.205                         | 6.3                             | Operation in Restricted Band | Complies       |
| 15.207                         | 6.6                             | Conducted Emissions          | Complies       |
| 15.209                         | 6.3                             | Radiated Emissions           | Complies       |
| 15.247 (a)(2)                  | 6.2.2(o)(iv)                    | Channel Bandwidth            | Complies       |
| 15.247 (b)(3)                  | 6.2.2(o)(b)                     | Peak Output Power            | Complies       |
| 15.247 (b)(5)                  |                                 | Radio Frequency Hazard       | Complies       |
| 15.247 (c)                     | 6.2.2(o)(e1)                    | Out of Band Emissions        | Complies       |
| 15.247 (d)                     | 6.2.2(o)(iv)                    | Peak Power Spectral Density  | Complies       |

Refer to EMC Technologies Report No: M050533\_Cert\_WM3B2915ABG\_11abg\_DTS\_BT

### 1.1.3 Bluetooth - FCC Subpart C, Section 15.247

| FCC Part 15, Subpart C Clauses | Industry Canada RSS-210 Clauses | Test Performed               | Result         |
|--------------------------------|---------------------------------|------------------------------|----------------|
| 15.203                         | 5.5                             | Antenna Requirement          | Not Applicable |
| 15.205                         | 6.3                             | Operation in Restricted Band | Complies       |
| 15.207                         | 6.6                             | Conducted Emissions          | Complies       |
| 15.209                         | 6.3                             | Radiated Emissions           | Complies       |
| 15.247 (a)(1)&(3)              | 6.2.2(o)(ii)                    | Channel Occupancy/Bandwidth  | Complies       |
| 15.247 (b)(1)                  | 6.2.2(o)(b)                     | Peak Output Power            | Complies       |
| 15.247 (b)(5)                  |                                 | Radio Frequency Hazard       | Complies       |
| 15.247 (c)                     | 6.2.2(o)(e1)                    | Out of Band Emissions        | Complies       |

Refer to EMC Technologies Report No: M050533\_Cert\_BT\_WM3B2915ABG\_11abg

The measurement procedure used was in accordance with ANSI C63.4-2003 and OET Bulletin No. 65. The instrumentation conformed to the requirements of ANSI C63.2-1996.

## 1.2 Modifications by EMC Technologies

No modifications were required.



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## 2.0 GENERAL INFORMATION

(Information supplied by the Client)

### 2.1 Product Details

|                                |  |
|--------------------------------|--|
| <b>Test Sample (Host PC):</b>  | LifeBook "C" Series                                  |
| <b>Model Number:</b>           | C1320  |
| <b>Serial Number:</b>          | Pre-production Sample                                |
| <b>Manufacturer:</b>           | Fujitsu Ltd  |
|                                |  |
| <b>CPU Type and Speed:</b>     | Pentium-M 2.26 GHz<br>Celeron-M 1.7 GHz              |
|                                |  |
| <b>Wired LAN:</b>              | Broadcom BCM5751M 10 Base-T/100 Base-TX/1000 Base-T) |
| <b>Modem:</b>                  | Agere MDC 1.5, Model: AM2                            |
| <b>Port Replicator Model:</b>  | FPCPR48 / FPCPR48AP                                  |
|                                |  |
| <b>AC Adapter Model:</b>       | SEC80P2-19.0 / UJ99                                  |
| <b>Voltage:</b>                | 19 V   |
| <b>Current Specs:</b>          | 3.16 A   |
| <b>Watts:</b>                  | 60 W   |
|                                |  |
| <b>Radio Modules:</b>          | WLAN (Calexico2 11a+b/g) and Bluetooth               |
| <b>WLAN Model Number:</b>      | WM3B2915ABG  |
| <b>WLAN Manufacturer:</b>      | Intel Corporation                                    |
| <b>Interface Type:</b>         | Mini-PCI Wireless LAN Module                         |
|                                |  |
| <b>Bluetooth Model Number:</b> | UGXZ5-102A   |
| <b>Bluetooth Manufacturer:</b> | Fujitsu Ltd  |
|                                |  |
| <b>FCC ID:</b>                 | EJE-WB0030   |
| <b>Industry Canada ID:</b>     | 337J-WB0030  |
| <b>Equipment Type:</b>         | Intentional Radiator (Transceiver)                   |



## 2.2 Technical Specifications

### 2.2.1 WLAN Transmitter Specifications

|                            |  |
|----------------------------|--|
| <b>Transmitter:</b>        | Mini-PCI Wireless LAN Module   |
| <b>Wireless Module:</b>    | Calexico2 (11a+b/g)  |
| <b>Model Number:</b>       | WM3B2915ABG  |
| <b>Manufacturer:</b>       | Intel Corporation  |
| <b>Modulation Type:</b>    | Direct Sequence Spread Spectrum (DSSS for 802.11b)<br>Orthogonal Frequency Division Multiplexing (OFDM for 802.11g)<br>Orthogonal Frequency Division Multiplexing (OFDM for 802.11a) |
| <b>802.11a</b>             | BPSK – 6Mbps, 9Mbps<br>QPSK – 12Mbps, 18Mbps<br>16QAM – 24Mbps, 36Mbps<br>64QAM – 48Mbps, 54Mbps   |
| <b>802.11g</b>             | BPSK – 6Mbps, 9Mbps<br>QPSK – 12Mbps, 18Mbps<br>16QAM – 24Mbps, 36Mbps<br>64QAM – 48Mbps, 54Mbps   |
| <b>802.11b</b>             | DBPSK – 1Mbps<br>DQPSK – 2Mbps<br>CCK – 5.5Mbps, 11Mbps  |
| <b>Maximum Data Rate:</b>  | 802.11b = 11Mbps, 802.11g and 802.11a = 54Mbps   |
| <b>Frequency Range:</b>    | 2.4 – 2483.5 GHz for 11b/g<br>5.15 - 5.35 GHz and 5.725 - 5.850 GHz for 11a  |
| <b>Number of Channels:</b> | 11 channels for 11b or 11g<br>13 channels for 11a  |
| <b>Antenna Types:</b>      | 2 x Nissei Electric Inverted-F, Model: CP250925<br>Located on top edge (left and right) of LCD screen  |
| <b>Antenna gain:</b>       | 802.11b/g = 0.73 dBi<br>802.11a (5.15 – 5.35 GHz) = 2.01 dBi<br>802.11a (5.725 – 5.825 GHz) = 3.08 dBi   |
| <b>Max. Output Power:</b>  | 802.11b = 15 dBm<br>802.11g = 14 dBm<br>802.11a = 10-14 dBm  |
| <b>Power Supply:</b>       | 3.3 VDC from PCI bus   |
| <b>Chipset Used:</b>       | 82533MDE and 82533RGE  |

#### Frequency allocation and maximum output power setting for 802.11b/g:

| Channel Number | Frequency (MHz) | EUT Power level setting dBm |         |
|----------------|-----------------|-----------------------------|---------|
|                |                 | 802.11b                     | 802.11g |
| 1              | 2412*           | 15                          | 14      |
| 2              | 2417            | 15                          | 14      |
| 3              | 2422            | 15                          | 14      |
| 4              | 2427            | 15                          | 14      |
| 5              | 2432            | 15                          | 14      |
| 6              | 2437*           | 15                          | 14      |
| 7              | 2442            | 15                          | 14      |
| 8              | 2447            | 15                          | 14      |
| 9              | 2452            | 15                          | 14      |
| 10             | 2457            | 15                          | 14      |
| 11             | 2462*           | 15                          | 14      |

\*Channels tested and reported in the DTS submission (M050533\_Cert\_WM3B2915ABG\_11abg\_DTS\_BT)



**Frequency allocation and maximum output power setting for 802.11a:**

| Channel Number   | Frequency (MHz) | Power level setting dBm |
|--|-----------------|-------------------------|
| *Channels tested and reported in the DTS submission<br>(M050533_Cert_WM3B2915ABG_11abg_DTS_BT) |                 |                         |
| <b>149</b>   | <b>5745*</b>    | <b>14</b>               |
| 153  | 5765            | 14                      |
| <b>157</b>   | <b>5785*</b>    | <b>14</b>               |
| 161  | 5805            | 14                      |
| <b>165</b>   | <b>5825*</b>    | <b>14</b>               |
| *Channels tested and reported in this report (UNII)  |                 |                         |
| <b>36</b>  | <b>5180*</b>    | <b>10</b>               |
| 40   | 5200            | 10                      |
| 44   | 5220            | 10                      |
| 48   | 5240            | 10                      |
| <b>52</b>  | <b>5260*</b>    | <b>14</b>               |
| 56   | 5280            | 14                      |
| 60   | 5300            | 14                      |
| <b>64</b>  | <b>5320*</b>    | <b>14</b>               |

**2.2.2 Bluetooth Transmitter Specifications**

|                              |   |
|------------------------------|---|
| <b>Transmitter:</b>          | Bluetooth   |
| <b>Model Number:</b>         | UGXZ5-102A  |
| <b>Manufacturer:</b>         | Fujitsu Ltd   |
| <b>Network Standard:</b>     | Bluetooth™ RF Test Specification  |
| <b>Modulation Type:</b>      | Frequency Hopping Spread Spectrum (FHSS)                                    |
| <b>Frequency Range:</b>      | 2402 MHz to 2480 MHz  |
| <b>Number of Channels:</b>   | 79  |
| <b>Carrier Spacing:</b>      | 1.0 MHz   |
| <b>Antenna Types:</b>        | Yokowo Antenna, Model: YCE-5250<br>Located on the right hinge of LCD screen |
| <b>Antenna gain:</b>         | 0.6 dBi   |
| <b>Max. Output Power:</b>    | 12 dBm  |
| <b>Reference Oscillator:</b> | 16 MHz (Built-in)   |
| <b>Power Supply:</b>         | 3.3 VDC from host.  |

**Frequency allocation:**

| Channel Number | Frequency (MHz) | Bluetooth Utility power setting |
|----------------|-----------------|---------------------------------|
| <b>1*</b>      | <b>2402</b>     | Power (Ext, Int) = 180, 50      |
| 2              | 2403            |                                 |
| 3              | 2404            |                                 |
| .              | .               |                                 |
| .              | .               |                                 |
| .              | .               |                                 |
| 39             | 2440            |                                 |
| <b>40*</b>     | <b>2441</b>     |                                 |
| 41             | 2442            |                                 |
| .              | .               |                                 |
| .              | .               |                                 |
| .              | .               |                                 |
| 77             | 2478            |                                 |
| 78             | 2479            |                                 |
| <b>79*</b>     | <b>2480</b>     |                                 |

\*Channels tested and reported in the Bluetooth submission (M050533\_Cert\_BT\_WM3B2915ABG\_11abg)





## 2.3 Operational Description

The EUT is a LifeBook "C" Series, Model: C1320 installed with a Mini-PCI Wireless LAN (WLAN) Module (Calexico2 11a+b/g, Model WM3B2915ABG) & Bluetooth, Model UGXZ5-102A.

The same WLAN radio module and Bluetooth combination has been previously certified by Fujitsu under FCC ID: EJE-WB0019 and IC: 337J-WB0019 in a different host.

The intention of this application is to re-certify this WLAN and Bluetooth with a different antenna combination in host – LifeBook "C" Series, Model: C1320.

## 2.4 Test Configuration

The Intel WLAN software and the BlueSuiteCasira software were used to set-up the WLAN module and Bluetooth devices respectively to continuously transmit during the tests. The LCD screen was observed for the transmitter status shown for the respective software.

Data Transmission is always initiated by software, which is then passed down through the MAC, through the digital and analog baseband, finally to the RF chip. Several special packets (ACKs, CTS, PSpoll, etc) are initiated by the MAC. These are the only ways the digital baseband portion will turn on the RF transmitter, which then turns off at the end of the packet. Therefore, the transmitter will be ON only while one of the four mentioned packets is being transmitted.

### Antenna

The Calexico2 (11a+b/g) WLAN, Model WM3B2915ABG is configured with Nissei Electric Inverted-F Antenna – Model: CP250925 and ALPS Bluetooth device, Model UGXZ5-102A is configured with Yokowo Antenna - Model: YCE-5250. The installation of the OEM WLAN module, Bluetooth Device and the Antenna in Fujitsu LifeBook "C" Series, Model: C1320 is in a controlled environment. The installation is performed during the production/assembly process at the Fujitsu factory.

Refer to Appendix F – Antenna Information.

There are three antennas: WLAN antennas (x2) are located on the right hand side and left hand side on the top edge of the LCD screen. Bluetooth antenna is located on the right hinge of LCD screen.

Refer to photos in Appendix B3 for WLAN Antenna locations.

### AC Adapter

The AC adapter SEC80P2-19.0 was used for all the tests. Details of the AC adapter are supplied in section 2.1 of this report.

## 2.5 Block Diagram

Refer to Appendix D - Block Diagram



## 2.6 Support Equipment

Refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-053EAL)

## 2.7 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-2003. Radiated emissions tests were performed at a distance of 3 and 1 metres from the EUT. OET Bulletin 65 dated June 2001 was used for reference.

## 2.8 Test Facility

### 2.8.1 General

Radiated Emission measurements were performed at EMC Technologies open area test site (OATS) situated at Lerderderg Gorge, near the township of Bacchus Marsh in Victoria, Australia. Conducted emission measurements were performed at EMC Technologies' laboratory in Tullamarine, Victoria Australia.

The above sites have been fully described in a report submitted to the FCC office, and accepted in a letter dated June 14, 2002, **FCC Registration Number 90560**.

EMC Technologies open area test site (OATS) has also been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS 212, Issue 1 (Provisional).

**Industry Canada File Number, IC 4161**, (Registration Date - November 5<sup>th</sup> 2001).

### 2.8.2 NATA Accreditation

EMC Technologies is accredited in Australia to test to the following standards by the National Association of Testing Authorities (NATA).

***“FCC Part 15 unintentional and intentional emitters in the frequency range 9kHz to 18 GHz excluding TV receivers (15.117 and 15.119), TV interface devices (15.115), cable ready consumer electronic equipment (15.118), cable locating equipment (15.213) and unlicensed national information infrastructure devices (Sub part E).”***

The current full scope of accreditation can be found on the NATA website: [www.nata.asn.au](http://www.nata.asn.au)  
It also includes a large number of emission, immunity, SAR, EMR and Safety standards.

NATA is the Australian national laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Laboratory (NML) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A<sup>2</sup>LA).



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## **2.9 Units of Measurements**

### **2.9.1 Conducted Emissions**

Measurements are reported in units of dB relative to one microvolt. (dB $\mu$ V).

### **2.9.2 Radiated Emissions**

Measurements are reported in units of dB relative to one microvolt per metre (dB $\mu$ V/m).

## **2.10 Test Equipment Calibration**

All measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent Technologies (Australia) Pty Ltd or the National Measurement Laboratory (NML). All equipment calibration is traceable to Australia national standards at the National Measurements Laboratory. The reference antenna calibration was performed by NML and the working antennas (horn, biconical and log-periodic) calibrated by the NATA approved procedures. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in Appendix A.

## **2.11 Ambients at OATS**

The Open Area Test Site (OATS) is an area of low background ambient signals. No significant broadband ambients are present however commercial radio and TV signals exceed the limit in the FM radio, VHF and UHF television bands. Radiated prescan measurements were performed in the shielded enclosure to check for possible radiated emissions at the frequencies where the OATS ambient signals exceeded the test limit.



## RESULTS

### WLAN Module – WM3B2915ABG (802.11a (NII) of Callexico2 11a+b/g)

#### 3.0 CONDUCTED EMISSION MEASUREMENTS

Testing was performed in accordance with the requirements of FCC Part 15.207  
Refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-053EAL)

#### 4.0 RADIATED EMISSION MEASUREMENTS

##### 4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.407(b).

Radiated emission measurements were performed to the limits as per section 15.209 and 15.407. The measurements were made at the open area test site.

The EUT was set up on the table top (placed on turntable) of total height 80 cm above the ground plane, and operated as described in section 2 of this report. The EMI Receiver was operated under software control via the PC Controller through the IEEE.488 Interface Bus Card Adaptor. The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks while also permitting fast frequency scan times. Calibrated EMCO 3115 and EMCO 3116 Horn antennas were used for measurements between 1 to 40 GHz.

The measurement of emissions between 30 - 1000 MHz, refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-053EAL).

The measurement of emissions above 1000 MHz, appearing in the restricted bands, was made using an average detector with a resolution bandwidth of 1.0 MHz.

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable, and by varying the antenna height. Each significant peak was investigated with the Quasi-Peak/Average Detectors. The measurement data for each frequency range was automatically corrected by the software for cable losses, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

##### 4.2 Calculation of field strength

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

**E = V + AF - G + L** Where:

- E** = Radiated Field Strength in dBμV/m.
- V** = EMI Receiver Voltage in dBμV. (measured value)
- AF** = Antenna Factor in dB(m<sup>-1</sup>). (stored as a data array)
- G** = Preamplifier Gain in dB. (stored as a data array)
- L** = Cable loss in dB. (stored as a data array of Insertion Loss versus frequency)

##### • Example Field Strength Calculation

Assuming a receiver reading of 34.0 dBμV is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9 dB while the preamplifier gain is 20 dB. The resulting Field Strength is therefore as follows:

$$34.0 + 9.2 + 1.9 - 20 = 25.1 \text{ dB}\mu\text{V/m}$$

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (1000 MHz – 18,000 MHz) ± 4.1 dB



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### 4.3 Results - Out of Band Emissions (Spurious and Harmonics)

#### 4.3.1 Frequency Band: 1 – 40 GHz

All measurements above 1 GHz were initially made over a distance of 3 metres. This was decreased to 1.0 metre as the emission levels from the device were very low.

The 54 dB $\mu$ V/m limit at 3 metres has been converted to 64 dB $\mu$ V/m at 1 metre using a factor of 20 dB per decade where emissions were located in the restricted bands.

The peak limits for undesirable emission outside of the restricted bands are –27 dBm (68.3 dB $\mu$ V/m @ 3m).

Measurements were performed on frequency band (5.15 - 5.35 GHz)

Testing was performed with the WLAN transmitter continuously operated. Harmonics related to the WLAN transmitter (5.15 – 5.35 GHz) are reported below. Harmonics in the frequency band (2.4 – 2.4835 GHz and 5725 – 5850 GHz), refer to M050533\_Cert\_WM3B2915ABG\_11abg\_NII\_BT. For harmonics related to the Bluetooth transmitter, refer to M050533\_Cert\_BT\_WM3B2915ABG\_11abg

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

The field strength at 5350 MHz when the EUT was operating at its highest channel (5320 MHz), was 68.7 dB $\mu$ V/m peak & 54.3 dB $\mu$ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5150 MHz when the EUT was operating at its lowest channel (5180 MHz), was 67.1 dB $\mu$ V/m peak & 54.2 dB $\mu$ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

##### 4.3.1.1 Configuration 802.11a (5.150 – 5.350 MHz)

###### Channel 36 – 5180 MHz

| Frequency MHz | Level dB $\mu$ V/m |                  | Antenna Polarization | Peak Limit dB $\mu$ V/m | Average Limit dB $\mu$ V/m | Result |
|---------------|--------------------|------------------|----------------------|-------------------------|----------------------------|--------|
|               | Peak Detector      | Average Detector |                      |                         |                            |        |
| 5180          | Transmitter        | Fundamental      |                      |                         |                            |        |
| 10360         | 52                 | 39               | Vert/Hort            | 68.3                    | -                          | Pass   |
| 15540         | 59                 | 46               | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 20720         | 64                 | 50               | Vert/Hort            | 84.0* (1m)              | 64.0* (1m)                 | Pass   |
| 25900         | 68                 | 54               | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |
| 31080         | 78                 | 64               | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |
| 36260         | 84**               | 70               | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |

\*Measurement was performed at 1 metre distance and the limits were corrected accordingly.

\*\*Refer to results



**Channel 52 – 5260 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5260          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 10520         | 52            | 39               | Vert/Hort            | 68.3              | -                    | Pass   |
| 15780         | 59            | 46               | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 21040         | 64            | 50               | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 26300         | 68            | 54               | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 31560         | 78            | 64**             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 36820         | 84**          | 70               | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

\*Measurement was performed at 1 metre distance and the limits were corrected accordingly.

\*\*Refer to results

**Channel 64 – 5320 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5320          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 10640         | 52            | 39               | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 15960         | 59            | 46               | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 21280         | 64            | 50               | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 26600         | 68            | 54               | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 31920         | 78            | 64               | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 37240         | 84**          | 70               | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

\*Measurement was performed at 1 metre distance and the limits were corrected accordingly.

\*\*Refer to results

**Result:** No harmonics were recorded within the restricted bands of up to 40 GHz. Harmonics were confirmed low with both RBW and VBW reduced (the peak and average levels listed in the above tables were noise floor readings). Harmonics were complied with the FCC limits in section 15.209 and 15.407. The measurement uncertainty for radiated emissions in this band was  $\pm 4.1$  dB.

**4.3.2 Frequency Band: 30 - 1000 MHz**

Refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-053EAL).



#### **4.3.3 RF Conducted Measurements at the antenna terminal**

In the 100 kHz bandwidth within the operating band, the highest emissions (spurious/harmonics) level that is produced by the intentional radiator shall be at least 20 dB below.

The transmitter output was connected to the spectrum analyser in peak hold mode.

The resolution bandwidth of 300 kHz and the video bandwidth of 1000 kHz were utilised.

Refer to Appendix J for Harmonics plots

**Result:** Complies.

#### **4.3.4 Band Edge Measurements**

The transmitter output was connected to the spectrum analyser in peak hold mode.

The resolution bandwidth of 1000 kHz and the video bandwidth of 1000 kHz were utilised.

Testing was performed while transmitter continuously transmitted on a low and high frequency channel of frequency band (5.150 – 5.350 GHz)

Refer to Appendix K for Band Edge plots

*NB:* D1 indicates the limit line for undesirable emission frequencies outside the operation frequency band.

**Result:** Complies.



## 5.0 PEAK OUTPUT POWER - Section 15.407(a)

Testing was performed in accordance with the requirements of FCC Part 15.407(a)(4)

Measurements were performed while the WLAN transmitter continuously transmitted.

The transmitter output was connected to the spectrum analyser in peak hold mode.

The peak output power measurement was performed using the integration method as per test method # 3 of DA 02-2138. The resolution bandwidth of 1 MHz was used. The video bandwidth of 100 kHz was used ( $VBW \geq 1/T$ , where  $T$  (worst case) = 170  $\mu$ S).

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Power with BPSK modulation (rate = 6 Mbps) was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 6Mbps (BPSK).

| Frequency MHz | P dBm | Limit dBm | P mW | Limit mW | Result |
|---------------|-------|-----------|------|----------|--------|
| 5180          | 14.2  | 17        | 26.3 | 50       | Pass   |
| 5260          | 16.1  | 24        | 40.7 | 250      | Pass   |
| 5320          | 16.6  | 24        | 45.7 | 250      | Pass   |

Variation by +/- 15% of the supply voltage, in accordance with Section 15.31(e), to the computer power supply did not vary the output power observed.

**Result:** Complies.

## 6.0 CHANNEL BANDWIDTH

Testing was performed in accordance with the requirements of FCC Part 15.407(a)

The 26 dB bandwidth was measured while the transmitter continuously transmitted.

The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.

The resolution bandwidth of 300 kHz and the video bandwidth of 1000 kHz were utilised

Measurements were performed on frequency band (5.150 – 5.350 GHz)

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in bandwidth were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

| Channel | Frequency MHz | Bandwidth MHz | 26 dB Bandwidth Plots |
|---------|---------------|---------------|-----------------------|
| 36      | 5180          | 22.6          | Appendix I            |
| 52      | 5260          | 22.3          | Appendix I            |
| 64      | 5320          | 22.6          | Appendix I            |





## 7.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

Testing was performed in accordance with the requirements of FCC Part 15.407(f)

Spread spectrum transmitters operating in the 5.150 – 5.350 GHz and 5.725 – 5.825 GHz bands are required to be operated in a manner that ensures that the public is not exposed to RF energy levels in accordance with CFR 47, Section 1.1307(b)(1).

Transmitter # 1: The WLAN is a mobile device. The antennas are located on the top edge of LCD screen (2 antennas left and right) projected distance of greater than 20cm from the user.

Transmitter # 2: The Bluetooth is a portable device. The antenna is located on the right hinge of LCD screen projected distance of greater than 2.5cm from the bottom of the laptop.

The separation distance between the WLAN and BT antennas is greater than 20cm. Therefore, they are not co-located transmitters.

MPE calculation for Bluetooth is not applicable and SAR is not required as the power for BT is below the low threshold.

The MPE calculation shown below is for the WLAN mobile device for a separation distance of greater than 20cm.

In accordance with Section 1.1310, the Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure of 1.0 has been applied, i.e  $1\text{mW}/\text{cm}^2$ .

Friis transmission formula:  $P_d = (P \cdot G) / (4 \cdot \pi \cdot r^2)$

where:  $P_d$  = power density ( $\text{mW}/\text{cm}^2$ )

$P$  = power input to the antenna (mW)

$G$  = antenna gain (numeric)

$r$  = distance to the center of radiation of the antenna (cm)

### The result was extracted from section 5.0 of this report (WLAN Module):

Maximum peak output power = 16.6 dBm = 45.7 mW

Antenna (Inverted F) gain (typical) = 2.01 dBi = 1.59 numeric

Prediction distance = 20 cm

Prediction frequency = 5320 MHz

MPE limit for uncontrolled exposure at prediction frequency =  $1\text{ mW}/\text{cm}^2$

The power density calculated =  $0.015\text{ mW}/\text{cm}^2$

**Results:** Calculations show that the Radio devices with described antennas complied with Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure



**8.0 PEAK POWER SPECTRAL DENSITY - Section 15.407 (a)**

Testing was performed in accordance with the requirements of FCC Part 15.407(a)(5)

The peak power spectral density measurement was performed as per test method #2 of DA 02-2138. The resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz were utilised.

Measurements were performed on frequency bands (5.150 – 5.350 GHz)

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Peak power spectral density with BPSK modulation (rate = 6 Mbps) was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 6 Mbps (BPSK).

| Channel | Frequency MHz | Peak Power Spectral Density (dBm) | Limit (dBm) | Result   | Spectral Density plots |
|---------|---------------|-----------------------------------|-------------|----------|------------------------|
| 36      | 5180          | -3.83                             | 4.0         | Complies | Appendix L             |
| 52      | 5260          | -0.96                             | 11.0        | Complies | Appendix L             |
| 64      | 5320          | -0.72                             | 11.0        | Complies | Appendix L             |

**Result:** Complies.

**9.0 PEAK EXCURSION - Section 15.407 (a)**

Testing was performed in accordance with the requirements of FCC Part 15.407(a)(6)

The transmitter output was connected to the spectrum analyser with a span setting to capture the entire emission bandwidth of the signal.

The peak transmit power was measured over an interval of continuous transmission using a calibrated spectrum analyser with the resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz for Trace 1 and video bandwidth of 100 kHz for Trace 2. The difference between Trace 1 and Trace 2 was recorded.

Measurements were performed on frequency bands (5.150 – 5.350 GHz)

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in peak excursion were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

| Channel | Frequency MHz | Peak Power Excursion (dB) | Limit (dB) | Result   | Peak Excursion plots |
|---------|---------------|---------------------------|------------|----------|----------------------|
| 36      | 5180          | 6.9                       | 13.0       | Complies | Appendix M           |
| 52      | 5260          | 5.9                       | 13.0       | Complies | Appendix M           |
| 64      | 5320          | 6.7                       | 13.0       | Complies | Appendix M           |

**Result:** Complies.



**10.0 FREQUENCY STABILITY**

Testing was performed in accordance with the requirements of FCC Part 15.407(g)

The transmitter output was connected to the spectrum analyser in peak hold mode.

The measurements were made at ambient room temperature and extreme (-20 to +55 °C) test conditions.

The AC supply voltage to the computer was varied by  $\pm 15\%$ . This was observed to have no effect on the results obtained.

Measurements were performed on frequency bands (5.150 – 5.350 GHz)

Testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

| Channel | Frequency MHz | Maximum Frequency Deviation kHz | Maximum Deviation % | $\pm 0.02$ % Limit kHz | Result   |
|---------|---------------|---------------------------------|---------------------|------------------------|----------|
| 36      | 5180          | 184                             | 0.004               | 1036                   | Complies |
| 52      | 5260          | 167                             | 0.004               | 1052                   | Complies |
| 64      | 5320          | 181                             | 0.004               | 1064                   | Complies |

**Result:** Complies.

**11.0 ANTENNA REQUIREMENT**

Testing to the requirements of FCC Part 15.203 was not applicable as this intentional radiator was designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.



## 12.0 COMPLIANCE STATEMENT

The LifeBook "C" Series, Model: C1320 with Mini-PCI Wireless LAN Module (Calexico2 11a+b/g, Model WM3B2915ABG) & Bluetooth, Model UGXZ5-102A, tested on behalf of Fujitsu Australia Ltd, **comply** with the requirements of 47 CFR, Part 15 Subpart E -Section 15.407 (5.15-5.35 GHz and 5.725-5.825 GHz bands).

The test sample also complies with the Industry Canada RSS-210 issue 5 (Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)) clause 6.2.2(q1) 5150-5350 MHz and 5725-5825 MHz Local Area Network Devices requirements and the RF exposure requirements of RSS-102.

Results were as follows:

### WLAN, Calexico2 802.11a (U-NII) - FCC Subpart E, Section 15.407

| FCC Part 15, Subpart E Clauses | Industry Canada RSS-210 Clauses | Test Performed               | Result                |
|--------------------------------|---------------------------------|------------------------------|-----------------------|
| 15.203                         | 5.5                             | Antenna Requirement          | <b>Not Applicable</b> |
| 15.205                         | 6.3                             | Operation in Restricted Band | <b>Complies</b>       |
| 15.207                         | 6.6                             | Conducted Emissions          | <b>Complies</b>       |
| 15.209                         | 6.3                             | Radiated Emissions           | <b>Complies</b>       |
| 15.407 (a)(4)                  | 6.2.2(q1)                       | Peak Transmit Power          | <b>Complies</b>       |
| 15.407 (a)(5)                  | 6.2.2(q1)                       | Peak Power Spectral Density  | <b>Complies</b>       |
| 15.407 (a)(6)                  |                                 | Peak Excursion               | <b>Complies</b>       |
| 15.407 (b)                     | 6.2.2(q1)                       | Undesirable Emission         | <b>Complies</b>       |
| 15.407 (f)                     |                                 | Radio Frequency Hazard       | <b>Complies</b>       |
| 15.407 (g)                     | 6.4                             | Frequency Stability          | <b>Complies</b>       |

The results for configurations IEEE 802.11b, IEEE 802.11g and IEEE802.11a (DTS: 5725 – 5850 MHz) and Bluetooth are reported separately.

Refer to EMC Technologies' test report: M050533\_Cert\_WM3B2915ABG\_11abg\_DTS\_BT (DTS) and M050533\_Cert\_BT\_WM3B2915ABG\_11abg (Bluetooth).



## TEST REPORT APPENDICES

**APPENDIX A: MEASUREMENT INSTRUMENTATION DETAILS**  
**APPENDIX B: REPORT PHOTOGRAPHS**  
**APPENDIX C: FUNCTIONAL DESCRIPTION**  
**APPENDIX D: BLOCK DIAGRAM**  
**APPENDIX E: SCHEMATICS**  
**APPENDIX F: ANTENNA INFORMATION**  
**APPENDIX G: FCC LABELLING DETAILS**  
**APPENDIX H: USER MANUAL**  
**APPENDIX I: CHANNEL BANDWIDTH PLOTS**  
**APPENDIX J: HARMONICS PLOTS**  
**APPENDIX K: BANDEDGE PLOTS**  
**APPENDIX L: PEAK POWER SPECTRAL DENSITY PLOTS**  
**APPENDIX M: PEAK EXCURSION PLOTS**

**Attachment 1: RF Exposure Information**

**Attachment 2: FCC DOC for LifeBook “C” Series**

**Attachment 3: FCC Part 15B Test Report (Report: FG05-053EAL)**



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