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**EMI TEST REPORT  
for  
CERTIFICATION to  
FCC PART 15 Subpart C (Section 15.247)  
& RSS-210**

**FCC ID:** EJE-WB0002  
**Industry Canada ID:** 337J-WB0002  
**Test Sample:** Mini-PCI WLAN (Atheros 11a+b/g) & Bluetooth Module

**WLAN Model:** WLL4030  
**Bluetooth Model:** UGXZ5-102A

**Report Number** M040124\_Cert\_Onion\_Atheros\_2.4\_BT

**Tested for:** Fujitsu Australia Ltd.

**Issue Date:** 20<sup>th</sup> February 2004

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**NATA Accredited Laboratory**  
**Number: 5292**

**EMI TEST REPORT FOR CERTIFICATION**  
**to**  
**FCC PART 15 Subpart C (Section 15.247) & RSS-210**  
**EMC Technologies Report No. M040124\_Cert\_Onion\_Atheros\_2.4\_BT**  
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**EMI TEST REPORT FOR CERTIFICATION to  
FCC PART 15 Subpart C (Section 15.247) & RSS-210**

**Report Number:** M040124\_Cert\_Onion\_Atheros\_2.4\_BT  
**Test Sample:** Mini-PCI WLAN (Atheros 11a+ b/g) & Bluetooth Module

**WLAN Model Number:** WLL4030  
**WLAN Manufacturer:** Askey Computer Corp.  
**Interface Type:** Mini-PCI Wireless LAN Module

**Bluetooth Model Number:** UGXZ5-102A  
**Bluetooth Manufacturer:** Fujitsu Japan Ltd

**FCC ID:** EJE-WB0002  
**Industry Canada ID:** 337J-WB0002  
**Equipment Type:** Intentional Radiator (Transceiver)

**Manufacturer (LifeBook):** Fujitsu Limited  
**Address:** 1405, Ohamaru, Inagi-shi, Tokyo 206-8503, Japan  
**Contact:** Mr. Kanbe Katsuhito

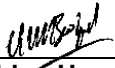
**Tested for:** Fujitsu Australia Ltd  
**Address:** 5 Lakeside Drive,  
Burwood East, VIC 3151 Australia  
**Phone:** +613 9845 4300  
**Fax:** +613 9845 4600  
**Contact:** Mr Praveen Rao – Senior Compliance Engineer

**Test Standards:** FCC Part 15, Subpart C – Intentional Radiators  
FCC Part 15.247, 2400 – 2483.5 MHz Operation Band  
ANSI C63.4 – 1992  
OET Bulletin No. 63

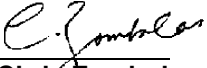
RSS-210 Issue 5 Low Power Licence-Exempt RadioCommunication  
Devices: 6.2.2 (o) 2400 – 2483.5 MHz Spread Spectrum

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:** 29<sup>th</sup> January to 10<sup>th</sup> February 2004

**Test Officer:**   
**Chieu Huynh** B.Eng (Hons) Electronics

**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**



## EMI TEST REPORT FOR CERTIFICATION to FCC PART 15 Subpart C (Section 15.247) & RSS-210

### 1.0 INTRODUCTION

EMI testing was performed on test sample Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4030 & ALPS Bluetooth Module, Model UGXZ5-102A.

The Atheros module supports IEEE 802.11a, IEEE 802.11b and IEEE 802.11g configurations. Tests were performed in all three configurations and also on the Bluetooth module. The results for configurations IEEE 802.11b, IEEE 802.11g and the Bluetooth module are reported in this test report. The results for IEEE 802.11a module are reported separately (refer to EMC Technologies' test report: M040124\_Cert\_Onion\_Atheros\_5.2\_BT).

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

|                             |                                                                    |
|-----------------------------|--------------------------------------------------------------------|
| 47 CFR, Part 15, Subpart C: | Rules for intentional radiators (particularly section 15.247)      |
| 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 15.247:             | Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz |

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.247.

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

### 1.1 Summary of Results

#### 1.1.1 WLAN, Atheros 802.11b/g - FCC PART 15 Subpart C (Section 15.247)

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

**Refer to Results – Part 1**



**1.1.2 WLAN, Atheros 802.11a - FCC PART 15 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 Bandwidth | 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       |

Refer to EMC Technologies Report No: M040124\_Cert\_Onion\_Atheros\_5.2\_BT

**1.1.3 Bluetooth Module - FCC PART 15 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 Bandwidth | 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 Results – Part 2

The measurement procedure used was in accordance with ANSI C63.4-1992 and OET Bulletin No. 96-43. The instrumentation conformed to the requirements of ANSI C63.2-1987.

**1.2 Modifications by EMC Technologies**

No modifications were required.

**2.0 GENERAL INFORMATION**

(Information supplied by the Client)

**2.1 Product Details**

Test Sample: Mini-PCI WLAN (Atheros 11a+b/g) and Bluetooth Module  
 WLAN Model Number: WLL4030  
 WLAN Manufacturer: Askey Computer Corp.  
 Interface Type: Mini-PCI Wireless LAN Module

Bluetooth Model Number: UGXZ5-102A  
 Bluetooth Manufacturer: Fujitsu Japan Ltd

FCC ID: EJE-WB0002  
 Industry Canada ID: 337J-WB0002  
 Equipment Type: Intentional Radiator (Transceiver)



**Host PC:** LifeBook S Series  
**Model Number:** S7010D  
**Code Name:** Onion  
**Serial Number:** Pre-production Sample  
**Manufacturer:** FUJITSU LIMITED

**CPU Type and Speed:** Dothan 1.8 GHz  
 Banias 1.7 GHz  
 Celeron-M 1.3 GHz  
**SDRAM:** 248 MB  
**LCD Screen:** 14.1"XGA  
**Hard Disk Drive:** 40 GB

**Wired LAN:** Broadcom 10/100 Base-Tx (On Board)  
 Broadcom GbLAN (On Board)  
**Modem:** MBH7MD33 / MBH7MD35  
**Wireless LAN (WLAN) Module:** Atheros 11a+b/g (WLL4030)  
 Atheros 11b/g (WLL3050)  
 Callexico2 11b/g (WM3B2200BG)  
**Port Replicator Model:** FPCPR48 / FPCPR48AP  
**Bluetooth Module:** ALPS Bluetooth Module  
**Bluetooth Model Number:** UGXZ5-102A

**AC Adapter Model:** SEB80N2-19.0 / SEB100P2-19.0  
**Alternate Models:** CA01007-093x / CA01007-092x  
**Voltage:** 19 V  
**Current Specs:** 3.16 A (SEB80N2-19.0), 4.22 A (SEB100P2-19.0)  
**Watts:** 60 W (SEB80N2-19.0), 80 W (SEB100P2-19.0)

**Additional AC Adapters:** Additional Optional AC adapters used with this notebook

| Manufacturer | Manufacturer's model name | Fujitsu P/N  | Rating    |
|--------------|---------------------------|--------------|-----------|
| Eastern      | UJ97                      | CA01007-0980 | 19V-3.16A |
| Tamura       | PTW1931N                  | CP196212-01  | 19V-3.16A |

## 2.2 Technical Specifications

### 2.2.1 WLAN Transmitter Specifications

**Transmitter #1:** Mini-PCI Wireless LAN Module  
**Wireless Module:** Atheros  
**Model Number:** WLL4030 (11a+b/g module)  
**Manufacturer:** Askey Computer Corp.

**Modulation Type:** Direct Sequence Spread Spectrum (DSSS for 802.11b)  
 Orthogonal Frequency Division Multiplexing (OFDM for 802.11g)  
 Orthogonal Frequency Division Multiplexing (OFDM for 802.11a)

**802.11a** BPSK – 6Mbps, 9Mbps  
 QPSK – 12Mbps, 18Mbps  
 16QAM – 24Mbps, 36Mbps  
 64QAM – 48Mbps, 54Mbps

**802.11g** BPSK – 6Mbps, 9Mbps  
 QPSK – 12Mbps, 18Mbps  
 16QAM – 24Mbps, 36Mbps  
 64QAM – 48Mbps, 54Mbps

**802.11b** DBPSK – 1Mbps  
 DQPSK – 2Mbps  
 CCK – 5.5Mbps, 11Mbps



**Maximum Data Rate:** 802.11b = 11Mbps, 802.11g and 802.11a = 54Mbps  
**Frequency Range:** 2.4 –2483.5 GHz for 11b/g  
 5.15 - 5.35 GHz and 5.725 - 5.825 GHz for 11a  
**Number of Channels:** 11 maximum (for 11b/11g)  
 12 maximum (for 11a) \*Passive Scan only  
**Antenna Type:** Monopole Ceramic Chip Antenna – YCE 5008  
**Max. Output Power:** 802.11b = 15 dBm  
 802.11g = 14.5 dBm  
 802.11a Band 1 (5.15 to 5.25 GHz) = 13.5 dBm  
 802.11a Band 2 (5.25 to 5.35 GHz) = 14 dBm  
 802.11a Band 3 (5.725 to 5.825 GHz) = 14.5 dBm  
**Power Supply:** 3.3 VDC from PCI bus  
**Chipset Used:** Atheros AR5212, AR5112  
  
**Turbo Mode:** For 802.11g & 802.11a only  
**Data rate (Turbo):** 12 MBps to 108 MBps

**Frequency allocation for 802.11b/g:**

| Channel Number | Frequency (MHz) | Turbo mode Frequency (MHz)<br>FOR 802.11g ONLY |
|----------------|-----------------|------------------------------------------------|
| 1              | 2412            | --                                             |
| 2              | 2417            | --                                             |
| 3              | 2422            | --                                             |
| 4              | 2427            | --                                             |
| 5              | 2432            | --                                             |
| 6              | 2437            | 2437                                           |
| 7              | 2442            | --                                             |
| 8              | 2447            | --                                             |
| 9              | 2452            | --                                             |
| 10             | 2457            | --                                             |
| 11             | 2462            | --                                             |

**Frequency allocation for 802.11a:**

| Channel Number | Frequency (MHz) | Turbo mode Frequency (MHz) |
|----------------|-----------------|----------------------------|
| 36             | 5180            | 5210                       |
| 40             | 5200            | --                         |
| 44             | 5220            | --                         |
| 48             | 5240            | 5250                       |
| 52             | 5260            | --                         |
| 56             | 5280            | 5290                       |
| 60             | 5300            |                            |
| 64             | 5320            |                            |
| 149            | 5745            |                            |
| 153            | 5765            | 5760                       |
| 157            | 5785            | --                         |
| 161            | 5805            | 5800                       |



## 2.2.2 Bluetooth Transmitter Specifications

**Transmitter#2:**  
**Module:** ALPS Bluetooth Module  
**Model Number:** UGXZ5-102A  
**Manufacturer:** Fujitsu Japan Ltd  
**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:** Monopole Ceramic Chip Antenna  
**Max. Output Power:** 12dBm  
**Reference Oscillator:** 16 MHz (Built-in)  
**Power Supply:** 3.3 VDC from host.

### Frequency allocation:

| Channel Number | Frequency (MHz) |
|----------------|-----------------|
| 1              | 2402            |
| 2              | 2403            |
| 3              | 2404            |
| .              | .               |
| .              | .               |
| .              | .               |
| 39             | 2440            |
| 40             | 2441            |
| 41             | 2442            |
| .              | .               |
| .              | .               |
| .              | .               |
| 77             | 2478            |
| 78             | 2479            |
| 79             | 2480            |





## 2.3 Operational Description

The EUT is a Mini-PCI Wireless LAN (WLAN) Module (Atheros 11a+b/g, Model WLL4030) & ALPS Bluetooth Module, Model UGXZ5-102A (installed in Host PC – LifeBook S Series, Model S7010D (Onion)).

The WLAN module is an OEM product from Askey Computer Corp., which is already certified by FCC ID: H8NWLL4030 and IC: 1353A-WLL4030 and re-certified by Fujitsu Ltd under FCC ID: EJE-WL0004 and IC:337J-WL0004.

The intention of this application is to certify the WLAN module and Bluetooth module in the following **Factory-set** LifeBook configurations.

| WLAN Module Atheros 11a+b/g, WLL4030 |                            |                        |                            |                     |
|--------------------------------------|----------------------------|------------------------|----------------------------|---------------------|
| Antenna Type                         | Antenna Gain dBi Max       | Host LifeBook Codename | Host LifeBook Model Number | Radio Configuration |
| Mono-pole Ceramic Chip               | 11a = 1.79<br>11b/g = 2.08 | Onion                  | S7010D                     | WLAN + BT           |
|                                      |                            | Onion                  | S7010D                     | WLAN Only           |
|                                      |                            | Onion                  | S7010D                     | BT Only             |

The differences in the Host LifeBook models are mainly:

CPU speeds, LCD Screen sizes (14.1" – 13.3") and physical size of the notebooks. The WLAN module, Bluetooth and Antenna are identical and located identically.

According to the manufacturer - any other similar LifeBook models not listed above but using the same WLAN and Antenna configurations shall also be subject to this application.

The measurements reported in this test report are for Onion with Mono-pole Ceramic Chip Antenna representing the various LifeBooks shown in the table above.

## 2.4 Test Configuration

The Askey 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.

### Antenna

The Atheros (11a+b/g) WLAN, Model WLL4030 and ALPS Bluetooth device, Model UGXZ5-102A are configured with a Monopole Ceramic Chip antenna, Model YCE-5008. The installation of the OEM WLAN module, Bluetooth Device and the Antenna in Fujitsu LifeBook S Series, Model S7010D (Onion) is in a controlled environment. The installation is performed during the production/assembly process at the Fujitsu factory.

Refer to Appendix N – Antenna Information.

### AC Adapter

There are two AC adapter models (SEB80N2-19.0 and SEB100P2-19.0) that were tested with this notebook. Details of the AC adapters are supplied above. The manufacturer has stated that the alternate model numbers (CA1007-093x and CA01007-092x) of these adapters are identical electrically and mechanically. The other two optional adapters listed in table above are to be modular approved in this application.

## 2.5 Block Diagram

Refer to Appendix D - Block Diagram



## 2.6 Support Equipment

### External Monitor/s:

Conducted EMI Videocom, Model DCM-1588VAE, FCC ID: H79DCM-1588  
Radiated EMI Hewlett Packard 15" Color monitor, Model D2827A,  
FCC ID: C5F7NFCMC1515X

### Printer:

Diconix, Model: 150 , FCC ID: E759WG-RBCN150

### USB Floppy Drives:

Fujitsu Model: FPCFDD11, P/N CP032173-01  
Fujitsu Model: FPCFDD12, P/N CP078720-01  
USB OMNI Floppy Drive Model # USB F3501 SN W316000096

### Headphones:

Verbatim Multimedia Stereo headset

### Modem:

Maestro Companion Series 3

### PS2 Mouse:

Microsoft Intellimouse, S/N 00723014, FCC ID: C3KKS9

### PS2 Keyboard

Logitech, Model: YBA9, S/N MCT94602411

### LAN Hub:

Kingston SOHO Hub Model: KNE8TP/H (FCC ID: JICKNE8TP-HO)

### PCMCIA Slot:

6 MB Compact flash card with Adapter, Apacer P/N 88.10200030

### Secure Digital Slot:

32 MB Secure Digital storage device

## 2.7 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-1992. Radiated emissions tests were performed at a distance of 3 and 10 metres from the EUT. OET Bulletin 63 dated October 1993 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).



## **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 (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 of this report.

## **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 – PART 1

### WLAN Module - Atheros 802.11b/g (WLL4030)

#### 1.0 CONDUCTED EMISSION MEASUREMENTS

Testing was performed in accordance with the requirements of FCC Part 15.207

##### 1.1 Test Procedure

The arrangement specified in ANSI C63.4-1992 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2-1987 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured.

##### 1.2 Peak Maximising Procedure

The various operating modes of the system were investigated. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

##### 1.3 Calculation of Voltage Levels

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

$$VEMI = VRx + LBPF$$

Where:

- VEMI** = the Measured EMI voltage in dBμV to be compared to the limit.
- VRx** = the Voltage in dBμV read directly at the EMI receiver.
- LBPF** = the insertion loss in dB of the cables and the Limiter and Pass Filter.

##### 1.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were then concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph were subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

##### 1.5 Results of Conducted Emission Measurements (AC Mains Ports)

Conducted Emission Measurements were performed on the LifeBook S Series, Model S7010D with WLAN module (Atheros – 11a+b/g, WLL4030) and Bluetooth module (UGXZ5-102A). Measurements were tested individually with both adapters (SEB80N2-19.0 and SEB100P2-19.0) and both measurements results are reported.

Initial investigations were performed with the WLAN in both configurations (802.11b and 802.11g) and all modulation types: (BPSK, QPSK, 16QAM, 64QAM, DBPSK, DQPSK and CCK). No significant differences in emissions were observed. Final testing was performed while the WLAN transmitter continuously operated with configuration 802.11g on the high (Channel 11, 2462 MHz) frequency channel with the modulation rate of 6 Mbps (BPSK) and the Bluetooth transmitter continuously operated on the low (Channel 1, 2402 MHz) frequency channel.

The reported frequencies in the tables below are mainly concerned with the Host PC emissions and not directly related to the WLAN module & Bluetooth module emissions.



**1.5.1 Test Sample with 60W adapter (SEB80N2-19.0)**

| Frequency MHz | Line    | Measured QP Level dB $\mu$ V | QP Limit dB $\mu$ V | $\Delta$ QP $\pm$ dB | Measured AV Level dB $\mu$ V | AV Limit dB $\mu$ V | $\Delta$ AV $\pm$ dB |
|---------------|---------|------------------------------|---------------------|----------------------|------------------------------|---------------------|----------------------|
| 0.559         | Active  | 46.5                         | 56.0                | -9.5                 | 42.4                         | 46.0                | -3.6                 |
| 0.417         | Active  | 45.6                         | 57.5                | -11.9                | 39.8                         | 47.5                | -7.7                 |
| 0.277         | Active  | 48.1                         | 60.9                | -12.8                | 42.1                         | 50.9                | -8.8                 |
| 0.627         | Neutral | 41.7                         | 56.0                | -14.3                | 36.4                         | 46.0                | -9.6                 |
| 0.623         | Active  | 41.2                         | 56.0                | -14.8                | 34.4                         | 46.0                | -11.6                |
| 0.211         | Active  | 47.7                         | 63.2                | -15.5                | 41.5                         | 53.2                | -11.7                |
| 0.498         | Active  | 42.8                         | 56.0                | -13.2                | 33.2                         | 46.0                | -12.8                |
| 0.287         | Neutral | 48.0                         | 60.6                | -12.7                | 36.3                         | 50.6                | -14.3                |
| 0.430         | Neutral | 45.7                         | 57.3                | -11.6                | 31.2                         | 47.3                | -16.1                |
| 0.574         | Neutral | 46.2                         | 56.0                | -9.8                 | 29.7                         | 46.0                | -16.3                |

The worst case conducted EMI occurred at 0.559 MHz and complied with the quasi peak and average limits by margins of 9.5 dB and 3.6 dB respectively. The measurement uncertainty was  $\pm 2.0$  dB. Refer to Appendix I for plots of the conducted EMI measurements.

**Result:** Complies

**1.5.2 Test Sample with 80W adapter (SEB100P2-19.0)**

| Frequency MHz | Line    | Measured QP Level dB $\mu$ V | QP Limit dB $\mu$ V | $\Delta$ QP $\pm$ dB | Measured AV Level dB $\mu$ V | AV Limit dB $\mu$ V | $\Delta$ AV $\pm$ dB |
|---------------|---------|------------------------------|---------------------|----------------------|------------------------------|---------------------|----------------------|
| 0.209         | Neutral | 50.4                         | 63.2                | -12.9                | 44.7                         | 53.2                | -8.5                 |
| 0.214         | Active  | 49.4                         | 63.0                | -13.6                | 40.6                         | 53.0                | -12.4                |
| 0.510         | Neutral | 41.3                         | 56.0                | -14.7                | 32.9                         | 46.0                | -13.1                |
| 0.317         | Neutral | 46.3                         | 59.8                | -13.4                | 36.3                         | 49.8                | -13.5                |
| 0.618         | Neutral | 43.4                         | 56.0                | -12.6                | 31.6                         | 46.0                | -14.4                |
| 0.314         | Active  | 44.9                         | 59.9                | -15.0                | 35.3                         | 49.9                | -14.6                |
| 0.299         | Neutral | 47.9                         | 60.3                | -12.4                | 33.4                         | 50.3                | -16.9                |
| 0.440         | Neutral | 42.9                         | 57.1                | -14.2                | 29.6                         | 47.1                | -17.5                |
| 0.530         | Neutral | 38.8                         | 56.0                | -17.2                | 25.3                         | 46.0                | -20.7                |
| 0.155         | Neutral | 47.0                         | 65.7                | -18.8                | 32.5                         | 55.7                | -23.2                |

The worst case conducted EMI occurred at 0.209 MHz and complied with the quasi peak and average limits by margins of 12.9 dB and 8.5 dB respectively. The measurement uncertainty was  $\pm 2.0$  dB. Refer to Appendix I for plots of the conducted EMI measurements.

**Result:** Complies



## 2.0 RADIATED EMISSION MEASUREMENTS

### 2.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.247(c).

Radiated emission measurements were performed to the limits as per section 15.209. 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. A calibrated Biconical antenna was used for measurements between 30 MHz to 232 MHz and a calibrated Logperiodic antenna used for measurements between 230 MHz to 1000 MHz. Calibrated EMCO 3115 and EMCO 3116 Horn antennas were used for measurements between 1 to 25 GHz.

The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

The measurement of emissions above 1000 MHz, appearing in the restricted bands, was made using an average detector with a 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 software for cable losses automatically corrected the measurement data for each frequency range, 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.

### 2.2 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 insertion 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
- (30 MHz – 1,000 MHz) ± 3.7 dB



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

### 2.3.1 Frequency Band: 1 – 25 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.

Testing was performed while both the WLAN transmitter and Bluetooth transmitter continuously operated. Harmonics related to the WLAN transmitter are reported below. For harmonics related to the Bluetooth transmitter, Refer to Part 2 of this test report.

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2462 MHz), was 38.3 dB $\mu$ V/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 2400 MHz when the EUT was operating at its lowest channel (2412 MHz), was 35.8 dB $\mu$ V/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

Measurements for the WLAN were made on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

#### 2.3.1.1 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 11 Mbps (CCK).

#### Channel 1 - 2412 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 |                      |                         |                            |        |
| 2412          | Transmitter        | Fundamental      |                      |                         |                            |        |
| 4824          | 46.6               | 33.1             | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 7236          | 48.0               | 34.5             | Vert/Hort            | -                       | -                          | Pass   |
| 9648          | 48.3               | 35.8             | Vert/Hort            | -                       | -                          | Pass   |
| 12060         | 51.5               | 38.9             | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 14472         | 53.6               | 40.4             | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 16884         | 54.9               | 42.7             | Vert/Hort            | -                       | -                          | Pass   |
| 19296         | 56.2               | 44.2             | Vert/Hort            | 84.0* (1m)              | 64.0* (1m)                 | Pass   |
| 21708         | 57.9               | 45.3             | Vert/Hort            | -                       | -                          | Pass   |
| 24120         | 59.7               | 46.6             | Vert/Hort            | -                       | -                          | Pass   |

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



**Channel 6 - 2437 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2437          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 4874          | 47.3          | 36.6             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7311          | 48.5          | 38.0             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 9748          | 49.0          | 38.7             | Vert/Hort            | -                 | -                    | Pass   |
| 12185         | 51.8          | 40.2             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14622         | 53.3          | 41.5             | Vert/Hort            | -                 | -                    | Pass   |
| 17059         | 54.3          | 42.8             | Vert/Hort            | -                 | -                    | Pass   |
| 19496         | 56.2          | 44.4             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 21933         | 58.8          | 45.1             | Vert/Hort            | -                 | -                    | Pass   |
| 24370         | 60.0          | 46.4             | Vert/Hort            | -                 | -                    | Pass   |

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

**Channel 11 - 2462 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2462          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 4924          | 50.9          | 36.4             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7386          | 50.5          | 37.2             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 9848          | 49.1          | 38.8             | Vert/Hort            | -                 | -                    | Pass   |
| 12310         | 51.7          | 40.0             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14772         | 53.6          | 41.9             | Vert/Hort            | -                 | -                    | Pass   |
| 17234         | 54.8          | 43.3             | Vert/Hort            | -                 | -                    | Pass   |
| 19696         | 56.0          | 44.2             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 22158         | 58.7          | 45.6             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 24620         | 60.2          | 46.5             | Vert/Hort            | -                 | -                    | Pass   |

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

Harmonics were recorded within the restricted bands of up to 25 GHz and complied with the FCC Class B average limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions in this band was  $\pm 4.1$  dB.

**Result:** Complies





**2.3.1.2 Configuration 802.11g - Normal Operating Mode**

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 6 Mbps (BPSK).

**Channel 1 - 2412 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2412          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 4824          | 46.0          | 34.5             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7236          | 46.1          | 34.9             | Vert/Hort            | -                 | -                    | Pass   |
| 9648          | 47.7          | 35.3             | Vert/Hort            | -                 | -                    | Pass   |
| 12060         | 50.4          | 39.4             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14472         | 52.2          | 41.0             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 16884         | 54.6          | 41.9             | Vert/Hort            | -                 | -                    | Pass   |
| 19296         | 56.3          | 44.2             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 21708         | 58.1          | 45.0             | Vert/Hort            | -                 | -                    | Pass   |
| 24120         | 59.8          | 46.3             | Vert/Hort            | -                 | -                    | Pass   |

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

**Channel 6 - 2437 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2437          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 4874          | 45.6          | 34.3             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7311          | 46.2          | 35.8             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 9748          | 47.9          | 35.6             | Vert/Hort            | -                 | -                    | Pass   |
| 12185         | 50.1          | 39.5             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14622         | 52.2          | 41.0             | Vert/Hort            | -                 | -                    | Pass   |
| 17059         | 54.5          | 42.4             | Vert/Hort            | -                 | -                    | Pass   |
| 19496         | 56.0          | 43.7             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 21933         | 57.8          | 45.5             | Vert/Hort            | -                 | -                    | Pass   |
| 24370         | 60.2          | 46.5             | Vert/Hort            | -                 | -                    | Pass   |

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



**Channel 11 - 2462 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2462          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 4924          | 48.2          | 36.5             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7386          | 49.9          | 38.1             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 9848          | 47.8          | 35.3             | Vert/Hort            | -                 | -                    | Pass   |
| 12310         | 50.6          | 39.1             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14772         | 52.5          | 41.0             | Vert/Hort            | -                 | -                    | Pass   |
| 17234         | 54.1          | 42.8             | Vert/Hort            | -                 | -                    | Pass   |
| 19696         | 55.7          | 43.7             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 22158         | 58.0          | 45.3             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 24620         | 60.1          | 46.2             | Vert/Hort            | -                 | -                    | Pass   |

\*Measurement was performed at 1 metre distance and the limits were corrected accordingly. Harmonics were recorded within the restricted bands of up to 25 GHz and complied with the FCC Class B average limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions in this band was  $\pm 4.1$  dB.

**Result:** Complies

**2.3.1.3 Configuration 802.11g - Turbo Mode**

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 108 Mbps (64QAM).

**Channel 6 - 2437 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2437          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 4874          | 44.1          | 33.7             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7311          | 45.6          | 35.3             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 9748          | 46.2          | 36.0             | Vert/Hort            | -                 | -                    | Pass   |
| 12185         | 49.5          | 38.2             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14622         | 51.9          | 40.6             | Vert/Hort            | -                 | -                    | Pass   |
| 17059         | 54.0          | 42.5             | Vert/Hort            | -                 | -                    | Pass   |
| 19496         | 55.8          | 43.7             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 21933         | 57.9          | 45.4             | Vert/Hort            | -                 | -                    | Pass   |
| 24370         | 60.1          | 46.3             | Vert/Hort            | -                 | -                    | Pass   |

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

Harmonics were recorded within the restricted bands of up to 25 GHz and complied with the FCC Class B average limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions in this band was  $\pm 4.1$  dB.

**Result:** Complies



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

Testing was performed at a distance of 10 metres.

Measurements were tested individually with both adapters (SEB80N2-19.0 and SEB100P2-19.0) and it was found that the results were not significantly different.

Initial investigations were performed with the WLAN in both configurations (802.11b and 802.11g) and all modulation types: (BPSK, QPSK, 16QAM, 64QAM, DBPSK, DQPSK and CCK). No significant differences in emissions were observed. Final testing was performed while the WLAN transmitter continuously operated with configuration 802.11g on the high (Channel 11, 2462 MHz) frequency channel with the modulation rate of 6 Mbps (BPSK) and the Bluetooth transmitter continuously operated on the low (Channel 1, 2402 MHz) frequency channel.

The reported frequencies in the tables below are mainly concerned with the Host PC emissions and not directly related to the WLAN module & Bluetooth module emissions.

**Vertical Polarity**

| Frequency MHz | Polarisation | QP Measured dB $\mu$ V/m | QP Limit dB $\mu$ V/m | $\Delta$ QP $\pm$ dB |
|---------------|--------------|--------------------------|-----------------------|----------------------|
| 450.12        | Vertical     | 29.4                     | 36.0                  | -6.6                 |
| 137.79        | Vertical     | 25.5                     | 33.5                  | -8.0                 |
| 457.82        | Vertical     | 27.8                     | 36.0                  | -8.2                 |
| 122.87        | Vertical     | 23.2                     | 33.5                  | -10.3                |
| 203.64        | Vertical     | 22.4                     | 33.5                  | -11.2                |
| 33.45         | Vertical     | 16.5                     | 30.0                  | -13.5                |
| 38.25         | Vertical     | 16.2                     | 30.0                  | -13.9                |
| 101.53        | Vertical     | 18.9                     | 33.5                  | -14.6                |
| 100.06        | Vertical     | 18.9                     | 33.5                  | -14.6                |
| 199.66        | Vertical     | 18.6                     | 33.5                  | -14.9                |
| 123.67        | Vertical     | 17.5                     | 33.5                  | -16.0                |
| 108.18        | Vertical     | 17.3                     | 33.5                  | -16.2                |
| 55.57         | Vertical     | 12.7                     | 30.0                  | -17.3                |
| 126.03        | Vertical     | 15.6                     | 33.5                  | -17.9                |
| 406.87        | Vertical     | 18.0                     | 36.0                  | -18.0                |

**Horizontal Polarity**

| Frequency MHz | Polarisation | QP Measured dB $\mu$ V/m | QP Limit dB $\mu$ V/m | $\Delta$ QP $\pm$ dB |
|---------------|--------------|--------------------------|-----------------------|----------------------|
| 337.92        | Horizontal   | 27.2                     | 36.0                  | -8.8                 |
| 601.35        | Horizontal   | 26.6                     | 36.0                  | -9.4                 |
| 400.92        | Horizontal   | 25.7                     | 36.0                  | -10.3                |
| 321.52        | Horizontal   | 25.4                     | 36.0                  | -10.6                |
| 122.86        | Horizontal   | 22.4                     | 33.5                  | -11.1                |
| 81.91         | Horizontal   | 18.5                     | 30.0                  | -11.5                |
| 137.22        | Horizontal   | 21.6                     | 33.5                  | -11.9                |
| 122.43        | Horizontal   | 18.7                     | 33.5                  | -14.9                |
| 86.45         | Horizontal   | 14.3                     | 30.0                  | -15.7                |
| 108.72        | Horizontal   | 15.2                     | 33.5                  | -18.3                |
| 132.85        | Horizontal   | 14.5                     | 33.5                  | -19.0                |

The highest radiated emission peak occurred at 450.12 (Vertical polarity) and complied with FCC quasi peak limit by a margin of 6.6 dB. The measurement uncertainty in this band was  $\pm 3.7$  dB. Refer to tables above for results.

**Result:** Complies.



### 2.3.3 Band Edge Measurements

The highest emission level that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the operating band.

Testing was performed while the WLAN transmitter continuously transmitted on a low (2412 MHz) and high frequency (2462 MHz) channel.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were utilised.

#### 2.3.3.1 Atheros (WLL4030) - Configuration 802.11b

Refer to Appendix K1 for Band Edge plots

*NB:* D1 line indicates the highest level of the transmitter  
D2 line indicates 20 dB limit below D1.

#### 2.3.3.2 Atheros (WLL4030) - Configuration 802.11g

Refer to Appendix K2 for Band Edge plots

*NB:* D1 line indicates the highest level of the transmitter  
D2 line indicates 20 dB limit below D1.

**Result:** Complies.

## 3.0 PEAK OUTPUT POWER - Section 15.247 (b)(1) & (3)

Testing was performed in accordance with the requirements of FCC Part 15.247(b)(3).

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 (P) was calculated as follows:

$$P = R + G + C \quad \text{where} \quad \begin{array}{l} R \text{ is the recorded peak power} \\ G \text{ is the antenna gain in dBi \& } \\ C \text{ is the cable loss} \end{array}$$

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

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.



### 3.1 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). Power with CCK modulation (rate = 11 Mbps) was observed to be slightly worst (approximately 0.5 dB). Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK).

The resolution bandwidth of 20 MHz and the video bandwidth of 20 MHz were utilised.

| Frequency MHz | R dBm | Coax Loss dB | G dBi | P dBm | Limit dBm | P mW  | Limit mW |
|---------------|-------|--------------|-------|-------|-----------|-------|----------|
| 2412          | 18.2  | - 0.5        | 2.08  | 19.78 | 30        | 95.1  | 1000     |
| 2437          | 18.5  | - 0.5        | 2.08  | 20.08 | 30        | 101.9 | 1000     |
| 2462          | 18.8  | - 0.5        | 2.08  | 20.38 | 30        | 109.1 | 1000     |

The specification limit is 1W (30 dBm).

**Result:** Complies.

### 3.2 Configuration 802.11g - Normal Operating Mode

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 (approximately 0.5 dB). Final testing was performed while the transmitter continuously operated with the modulation rate of 6 Mbps (BPSK).

The resolution bandwidth of 20 MHz and the video bandwidth of 20 MHz were utilised.

| Frequency MHz | R dBm | Coax Loss dB | G dBi | P dBm | Limit dBm | P mW  | Limit mW |
|---------------|-------|--------------|-------|-------|-----------|-------|----------|
| 2412          | 21.0  | - 0.5        | 2.08  | 22.58 | 30        | 181.1 | 1000     |
| 2437          | 21.1  | - 0.5        | 2.08  | 22.68 | 30        | 185.4 | 1000     |
| 2462          | 21.4  | - 0.5        | 2.08  | 22.98 | 30        | 198.6 | 1000     |

The specification limit is 1W (30 dBm).

**Result:** Complies

### 3.3 Configuration 802.11g - Turbo Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in power were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (64QAM).

The resolution bandwidth of 50 MHz and the video bandwidth of 50 MHz were utilised.

| Frequency MHz | R dBm | Coax Loss dB | G dBi | P dBm | Limit dBm | P mW  | Limit mW |
|---------------|-------|--------------|-------|-------|-----------|-------|----------|
| 2437          | 20.8  | - 0.5        | 2.08  | 22.38 | 30        | 173.0 | 1000     |

The specification limit is 1W (30 dBm).

**Result:** Complies

#### 4.0 CHANNEL BANDWIDTH

Testing was performed in accordance with the requirements of FCC Part 15.247(a)(2)

In the band 2400 - 2483.5 MHz the minimum 6 dB bandwidth was at least 500 kHz. The 6 dB bandwidth was measured while the transmitter continuously transmitted on a low, middle and high frequency channel.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised

Measurements were made on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

#### 4.1 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). No significant differences in bandwidth were observed. Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK).

| Frequency MHz | Bandwidth MHz | Result   | 6 dB Bandwidth Plots |
|---------------|---------------|----------|----------------------|
| 2412.0        | 11.17         | Complies | Appendix J1          |
| 2437.0        | 10.50         | Complies | Appendix J1          |
| 2462.0        | 10.47         | Complies | Appendix J1          |

The minimum 6 dB bandwidth is at least 500 kHz

**Result:** Complies

#### 4.2 Configuration 802.11g - Normal Operating Mode

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).

| Frequency MHz | Bandwidth MHz | Result   | 6 dB Bandwidth Plots |
|---------------|---------------|----------|----------------------|
| 2412.0        | 16.53         | Complies | Appendix J2          |
| 2437.0        | 16.53         | Complies | Appendix J2          |
| 2462.0        | 16.53         | Complies | Appendix J2          |

The minimum 6 dB bandwidth is at least 500 kHz

**Result:** Complies

#### 4.3 Configuration 802.11g - Turbo Mode

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 108 Mbps (64QAM).

| Frequency MHz | Bandwidth MHz | Result   | 6 dB Bandwidth Plots |
|---------------|---------------|----------|----------------------|
| 2437.0        | 32.77         | Complies | Appendix J2          |

The minimum 6 dB bandwidth is at least 500 kHz

**Result:** Complies



## 5.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

Testing was performed in accordance with the requirements of FCC Part 15.247(b)(5)

Spread spectrum transmitters operating in the 2400 - 2483.5 MHz band 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).

In accordance with this section and also section 2.1091 this device has been defined as a mobile device whereby a distance of 20 cm normally can be maintained between the user and the device.

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 1mW/cm<sup>2</sup>.

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

where:  $P_d$  = power density (mW/cm<sup>2</sup>)

$P$  = 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 Part 1, section 3.0 of this report. (WLAN Module):**

Maximum peak output power at the antenna terminal = 21.4dBm = 138mW

Antenna (Monopole Ceramic Chip) gain (typical) = 2.08 dBi = 1.614 numeric

Prediction distance = 20 cm

Prediction frequency = 2462 MHz

MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm<sup>2</sup>

Therefore, the power density at prediction frequency ( $P_d$ ) = 0.0443 mW/cm<sup>2</sup>

**The result was extracted from Part 2, section 3.0 of this report. (Bluetooth Module):**

Maximum peak output power at the antenna terminal = 11.59dBm = 14.4mW

Antenna (Monopole Ceramic Chip) gain (typical) = 2.08 dBi = 1.614 numeric

Prediction distance = 20 cm

Prediction frequency = 2402 MHz

MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm<sup>2</sup>

Therefore, the power density at prediction frequency ( $P_d$ ) = 0.0046mW/cm<sup>2</sup>

The total power density (TPd) for WLAN and Bluetooth transmitters continuously operated:

$TP_d = 0.0443 \text{ (WLAN)} + 0.0046 \text{ (Bluetooth)} = 0.0489 \text{ mW/cm}^2$

**Results:           Complies**



## 6.0 PEAK POWER SPECTRAL DENSITY - Section 15.247(d)

Testing was performed accordance with the requirements of FCC Part 15.247(d)

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

The resolution bandwidth of 3 kHz and the video bandwidth of 30 kHz were utilised

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

### 6.1 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). No significant differences in peak power spectral density were observed. Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK).

| Frequency MHz | Level dBm | Limit dBm | Result   | Spectral Density plots |
|---------------|-----------|-----------|----------|------------------------|
| 2412.0        | - 9.32    | 8.0       | Complies | Appendix L1            |
| 2437.0        | - 6.81    | 8.0       | Complies | Appendix L1            |
| 2462.0        | - 6.48    | 8.0       | Complies | Appendix L1            |

The specification limit is 8 dBm in any 3 kHz band during a continuous transmission.

**Result:** Complies

### 6.2 Configuration 802.11g - Normal Operating Mode

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

| Frequency Hz | Level dBm | Limit dBm | Result   | Spectral Density plots |
|--------------|-----------|-----------|----------|------------------------|
| 2412.0       | - 8.73    | 8.0       | Complies | Appendix L2            |
| 2437.0       | - 6.34    | 8.0       | Complies | Appendix L2            |
| 2462.0       | - 6.43    | 8.0       | Complies | Appendix L2            |

The specification limit is 8 dBm in any 3 kHz band during a continuous transmission.

**Result:** Complies

### 6.3 Configuration 802.11g - Turbo Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in peak power spectral density were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (64QAM).

| Frequency Hz | Level dBm | Limit dBm | Result   | Spectral Density plots |
|--------------|-----------|-----------|----------|------------------------|
| 2437.0       | - 6.95    | 8.0       | Complies | Appendix L2            |

The specification limit is 8 dBm in any 3 kHz band during a continuous transmission.

**Result:** Complies





## 7.0 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.

## 8.0 COMPLIANCE STATEMENT

The Mini-PCI Wireless LAN (WLAN) Module, Model WLL4030 (Atheros 11a+b/g) and Bluetooth Module, Model UGXZ5-102A, tested on behalf of Fujitsu Australia Ltd, **comply** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 -Operation in the frequency band 2400 - 2483.5 MHz.

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(o) 2400 – 2483.5 MHz Spread Spectrum requirements and the RF exposure requirements of RSS-102.

Results were as follows:

### WLAN Module, Atheros 802.11b/g

| 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 Bandwidth | 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       |

### Bluetooth Module

| 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 Bandwidth | 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 Results – Part 2

NB: Refer to EMC Technologies' Report M040124\_Cert\_Onion\_Atheros\_5.2\_BT for Atheros 802.11a results.



## RESULTS – PART 2

### Bluetooth Module, Model UGXZ5-102A

#### 1.0 CONDUCTED EMISSION MEASUREMENTS

Testing was performed in accordance with the requirements of FCC Part 15.207

##### 1.1 Test Procedure

The arrangement specified in ANSI C63.4-1992 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2-1987 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured.

##### 1.2 Peak Maximising Procedure

The various operating modes of the system were investigated. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

##### 1.3 Calculation of Voltage Levels

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

$$VEMI = VRx + LBPF$$

Where:

- VEMI** = the Measured EMI voltage in dBμV to be compared to the limit.
- VRx** = the Voltage in dBμV read directly at the EMI receiver.
- LBPF** = the insertion loss in dB of the cables and the Limiter and Pass Filter.

##### 1.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were then concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph were subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

##### 1.5 Results of Conducted Emission Measurements (AC Mains Ports)

Refer to Results Part 1, Section 1.5.



## 2.0 RADIATED EMISSION MEASUREMENTS

### 2.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.247(c).

Radiated emission measurements were performed to the limits as per section 15.209. 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. A calibrated Biconical antenna was used for measurements between 30 MHz to 232 MHz and a calibrated Logperiodic antenna used for measurements between 230 MHz to 1000 MHz. Calibrated EMCO 3115 and EMCO 3116 Horn antennas were used for measurements between 1 to 25 GHz.

The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

The measurement of emissions above 1000 MHz, appearing in the restricted bands, was made using an average detector with a 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 software for cable losses automatically corrected the measurement data for each frequency range, 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.

### 2.2 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 insertion 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
- (30 MHz – 1,000 MHz) ± 3.7 dB



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

### 2.3.1 Frequency Band: 1 – 25 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.

Testing was performed while both the WLAN transmitter and Bluetooth transmitter continuously operated. Harmonics related to the Bluetooth transmitter are reported below. For harmonics related to the WLAN transmitter, Refer to Part 1 of this test report (802.11b/g) and EMC Technologies' Report M040124\_Cert\_Onion\_Atheros\_5.2\_BT (802.11a).

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2480 MHz), was 38.1 dB $\mu$ V/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 2400 MHz when the EUT was operating at its lowest channel (2402 MHz), was 35.5 dB $\mu$ V/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

Measurements for the WLAN were made on a low (channel 1, 2402 MHz), middle (channel 40, 2441 MHz) and high (Channel 79, 2480 MHz) frequency channel.

#### Channel 1 - 2402 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 |                      |                         |                            |        |
| 2402          | Transmitter        | Fundamental      |                      | -                       | -                          |        |
| 4804          | 46.2               | 35.0             | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 7206          | 49.0               | 38.5             | Vert/Hort            | -                       | -                          | Pass   |
| 9608          | 43.4               | 33.6             | Vert/Hort            | -                       | -                          | Pass   |
| 12010         | 48.8               | 36.9             | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 14412         | 50.3               | 38.4             | Vert/Hort            | -                       | -                          | Pass   |
| 16814         | 52.7               | 41.2             | Vert/Hort            | -                       | -                          | Pass   |
| 19216         | 54.6               | 43.0             | Vert/Hort            | 84.0* (1m)              | 64.0* (1m)                 | Pass   |
| 21618         | 56.9               | 44.7             | Vert/Hort            | -                       | -                          | Pass   |
| 24020         | 59.0               | 46.9             | Vert/Hort            | -                       | -                          | Pass   |

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



**Channel 40 - 2441 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2441          | Transmitter   | Fundamental      |                      | -                 | -                    |        |
| 4882          | 47.0          | 35.3             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7323          | 50.8          | 39.8             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 9764          | 43.9          | 33.4             | Vert/Hort            | -                 | -                    | Pass   |
| 12205         | 48.5          | 37.5             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14646         | 51.1          | 39.0             | Vert/Hort            | -                 | -                    | Pass   |
| 17087         | 52.7          | 41.3             | Vert/Hort            | -                 | -                    | Pass   |
| 19528         | 55.6          | 43.2             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 21969         | 57.3          | 45.9             | Vert/Hort            | -                 | -                    | Pass   |
| 24410         | 60.2          | 47.7             | Vert/Hort            | -                 | -                    | Pass   |

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

**Channel 79 - 2480 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 2480          | Transmitter   | Fundamental      |                      | -                 | -                    |        |
| 4960          | 48.2          | 36.9             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 7440          | 53.7          | 42.7             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 9920          | 44.9          | 34.0             | Vert/Hort            | -                 | -                    | Pass   |
| 12400         | 49.6          | 38.5             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 14880         | 51.6          | 39.1             | Vert/Hort            | -                 | -                    | Pass   |
| 17360         | 53.3          | 41.9             | Vert/Hort            | -                 | -                    | Pass   |
| 19840         | 55.8          | 43.2             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 22320         | 57.0          | 45.4             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 24800         | 59.5          | 46.7             | Vert/Hort            | -                 | -                    | Pass   |

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

Harmonics were recorded within the restricted bands of up to 25 GHz and complied with the FCC Class B average limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions in this band was  $\pm 4.1$  dB.

**Result:** Complies



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

Refer to Results Part 1, Section 2.3.2

**2.3.3 Band Edge Measurements**

The highest emission level that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the operating band.

Testing was performed while the Bluetooth transmitter continuously transmitted on a low (2402 MHz) and high frequency (2480 MHz) channel.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were utilised.

Refer to Appendix K3 for Band Edge plots

NB: D1 line indicates the highest level of the transmitter

D2 line indicates 20 dB limit below D1.

**Result:** Complies.

**3.0 PEAK OUTPUT POWER - Section 15.247 (b)(1) & (3)**

Testing was performed in accordance with the requirements of FCC Part 15.247(b)(3).

Measurements were performed while the Bluetooth transmitter continuously transmitted.

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

The resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz were utilised.

The Peak Output Power (P) was calculated as follows:

$$P = R + G + C \quad \text{where} \quad \begin{array}{l} R \text{ is the recorded peak power} \\ G \text{ is the antenna gain in dBi \& } \\ C \text{ is the cable loss} \end{array}$$

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2402 MHz), middle (channel 40, 2441 MHz) and high (Channel 79, 2480 MHz) frequency channel.

Variation by +/- 15% of the supply voltage, in accordance with section 15.31(e), to the computer power supply power did not cause any variations to the RF output power.

| Frequency MHz | R dBm | Coax Loss dB | G dBi | P dBm | Limit dBm | P mW | Limit mW |
|---------------|-------|--------------|-------|-------|-----------|------|----------|
| 2402.0        | 11.59 | - 0.5        | 2.08  | 13.17 | 30        | 20.7 | 1000     |
| 2441.0        | 11.35 | - 0.5        | 2.08  | 12.93 | 30        | 19.6 | 1000     |
| 2480.0        | 11.35 | - 0.5        | 2.08  | 12.93 | 30        | 19.6 | 1000     |

The specification limit is 1W (30 dBm).

**Result:** Complies.



#### 4.0 CHANNEL BANDWIDTH & CHANNEL OCCUPANCY

Testing was carried out in accordance with the requirements of FCC Part 15.247(a)(1)(i)&(iii)

The EUT was a Frequency Hopping Spread Spectrum transmitter and operated as described in section 2 of this report.

##### 4.1 Channel Bandwidth

In the band 2400 - 2483.5 MHz the hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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

A resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised.

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2402 MHz), middle (channel 40, 2441 MHz) and high (Channel 79, 2480 MHz) frequency channel.

| Frequency MHz | Bandwidth kHz | Result   | 20 dB Bandwidth Plots |
|---------------|---------------|----------|-----------------------|
| 2402          | 739           | Complies | Appendix J3           |
| 2441          | 733           | Complies | Appendix J3           |
| 2480          | 745           | Complies | Appendix J3           |

##### 4.2 Channel Occupancy

This measurement was made on a channel using a spectrum analyser with a 0 Hz span and a sweep time of 5 mS.

79 channels were observed operating between 2400 – 2483.5 MHz. Refer to Appendix M for number of channel plot.

The channel separation of 1 MHz was recorded.

The device was observed to have a dwell time of 420.8 uS. Refer to Appendix M for dwell time plot.

The specification allows for a dwell time not exceeding 0.4 seconds.

The maximum period is 79 channels x 0.4 seconds = 31.6 seconds

During the test the transmitter was observed to activate on average 325 times in 31.6 seconds.

The transmitter therefore occupies in one channel for  $325 \times 420.8\mu\text{S} = 0.137$  seconds

**Result:** Complies.



## 5.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

Refer to Results Part 1, Section 5.0

## 6.0 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.

## 7.0 COMPLIANCE STATEMENT

The Mini-PCI Wireless LAN (WLAN) Module, Model WLL4030 (Atheros 11a+b/g) and Bluetooth Module, Model UGXZ5-102A, tested on behalf of Fujitsu Australia Ltd, **comply** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 -Operation in the frequency band 2400 - 2483.5 MHz.

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(o) 2400 – 2483.5 MHz Spread Spectrum requirements and the RF exposure requirements of RSS-102.

Results were as follows:

### Bluetooth Module

| 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 Bandwidth | 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       |

### WLAN Module, Atheros 802.11b/g

| 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 Bandwidth | 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 Results – Part 1

NB: Refer to EMC Technologies' Report M040124\_Cert\_Onion\_Atheros\_5.2\_BT for Atheros 802.11a results.





## APPENDIX A MEASUREMENT INSTRUMENTATION DETAILS

| EQUIPMENT TYPE  | MAKE/MODEL<br>SERIAL NUMBER                                      | LAST CAL.<br>DD/MM/YY | DUE DATE<br>DD/MM/YY | CAL.<br>INTERVAL |
|-----------------|------------------------------------------------------------------|-----------------------|----------------------|------------------|
| EMI RECEIVER    | HP 8574B System Components                                       | 12/02/03              | 12/02/04             | 1 YEAR *2        |
| EMI RECEIVER    | Rohde & Schwarz, Model ESIB40<br>SN 1088 7490, 20 Hz – 40 GHz    | 09/07/03              | 09/07/04             | 1 YEAR *3        |
| EMI RECEIVER    | Rohde & Schwarz, Model FSET22<br>SN 1080 3508, 100 Hz – 22 GHz   | 31/10/03              | 31/10/04             | 1 YEAR *3        |
| RF PRE-SELECTOR | Rohde & Schwarz, Model FSET-Z22<br>SN 1070 2009, 100 Hz – 22 GHz | 31/10/03              | 31/10/04             | 1 YEAR *3        |
| ANTENNAS        | EMCO 93110B BICONICAL<br>20 - 300 MHz Sn. 9804-3092              | 20/08/03              | 20/08/04             | 1 YEAR *1        |
|                 | EMCO 93146A LOG PERIODIC<br>200 -1000MHz Sn. 5033                | 11/07/03              | 11/07/04             | 1 YEAR *1        |
|                 | EMCO 3115 DOUBLE RIDGED HORN<br>1 - 18 GHz Sn: 8908-3282         | 29/01/03              | 29/01/04             | 1 YEAR *1        |
|                 | EMCO 3116 Double Ridged Guide Horn<br>18 – 40 GHz Sn 2276        | -----                 | -----                | *4               |
| LISN            | EMCO 3825/2 50ohm / 50 microH<br>0.009 – 30MHz Sn.9607-2567      | 10/02/03              | 10/02/04             | 1 YEAR *1        |

Note \*1. In-house calibration. Refer to Quality Manual.

Note \*2. NATA calibration by Agilent Technologies (Aust) Pty Ltd

Note \*3. NATA calibration by Rohde & Schwarz

Note \*4. Manufacturer's calibration

## TEST SITES

|                                      |                                                                                                                                                                  |                             |                             |                                |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------|--------------------------------|
| <b>Shielded Room Test Laboratory</b> | <b>Melbourne</b><br>11m x 8m x 4m Chamber-semi-anechoic<br>8.8m x 5.8m x 3.1m Test Chamber<br>3.4m x 6.1m x 2.5m Test Chamber<br>3.4m x 7.3m x 7.5m Test Chamber | Feb 03<br>N/A<br>N/A<br>N/A | Feb 04<br>N/A<br>N/A<br>N/A | 1 Year *1<br>N/A<br>N/A<br>N/A |
| <b>Open Area Test Site</b>           | <b>Melbourne</b><br>3/10 Metre site. 1-4 metre antenna mast.<br>1.2 metre/400 kg Turntable. (Situated at Lerderberg Gorge, near Bacchus Marsh, Victoria)         | 21/01/03                    | 21/01/04                    | 1 Year *1                      |

Note \*1. In-house calibration. Refer to Quality Manual.



This Laboratory is accredited by the National Association of Testing Authorities, Australia. The tests reported herein have been performed in accordance with its terms of accreditation for FCC Part 15. This document shall not be reproduced, except in full.

## TEST REPORT APPENDICES

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**APPENDIX O: USER MANUAL**

**Attachment 1: Atheros\_11abg\_FCC\_Certificate**

**Attachment 2: Atheros\_11abg\_RSS\_Certificate**

**Attachment 3: FCC DOC for LifeBook Onion S7010D**

