



**EMC Technologies Pty Ltd**

ABN 82 057 105 549

57 Assembly Drive

Tullamarine Victoria Australia 3043

Ph: + 613 9335 3333

Fax: + 613 9338 9260

email: melb@emctech.com.au

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

**FCC ID:** EJE-WL0004  
**Industry Canada ID:** 337J-WL0004  
**Test Sample:** Stylistic Pentablet PC  
**Model Number:** ST5010D  
**Codename:** Ocampu  
**Wireless LAN Module:** Atheros  
**Model Number:** WLL4030 (11a+b/g module)  
**Tested for:** Fujitsu Australia Ltd.

**Issue Date:** 18<sup>th</sup> December 2003

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**NATA Accredited Laboratory  
Number: 5292**

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

**EMC Technologies Report No. M030949\_Certification\_Ocampa\_Atheros\_5.2**

**Issue Date: 18<sup>th</sup> December 2003**

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

**Report Number:** M030949\_Certification\_Ocampa\_Atheros\_5.2  
**Test Sample:** Stylistic Pentablet PC  
**Model Number:** ST5010D  
**Codename:** Ocampa  
**Wireless LAN Module:** Atheros  
**Model Number:** WLL4030 (11a+b/g module)  
**Equipment Type:** Intentional Radiator (Transceiver)  
**Manufacturer:** Askey Computer Corp.

**Manufacturer (Stylistic PC):** Fujitsu Limited  
**Address:** 1405, Ohamaru, Inagi-shi, Tokyo 206-8503, Japan  
**Contact:** Mr. Kanbe Katsuhito  
**FCC ID:** EJE-WL0004  
**Industry Canada ID:** 337J-WL0004

**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 E – Unlicensed National Information  
 Infrastructure Devices  
 FCC Part 15.407, General Technical Requirements  
 ANSI C63.4-1992  
 OET Bulletin No. 63

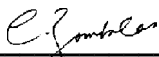
RSS-210 Issue 5 Low Power Licence-Exempt  
 RadioCommunication Devices:  
 6.2.2 (q1) 5150-5350 MHz & 5725-5825 MHz Local Area  
 Network Devices

RSS-102 Issue 1 (Provisional), Evaluation Procedure for  
 Mobile and Portable Radio Transmitters with respect to  
 Health Canada's Safety Code 6 for Exposure of Humans to  
 Radio Frequency Fields

**Test Dates:** 4<sup>th</sup> – 20<sup>th</sup> October 2003

**Test Officer:**   
**Chien 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 Signature:**   
**Chris Zombolas**  
**Technical Director**  
**EMC Technologies Pty Ltd**



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

### 1.0 INTRODUCTION

This report details the results of EMI tests and measurements performed on the Mini-PCI Wireless LAN Module (Atheros), Model WLL4030 installed in Stylistic Pentablet PC, Model ST5010D (Ocampa), in accordance with the following Federal Communications Commission (FCC) standards/regulations:

47 CFR, Part 15, Subpart E:      Unlicensed National Information Infrastructure Devices (U-NII)  
operating in the 5.15-5.35 GHz and 5.725-5.825 GHz frequency bands  
Section 15.407:                      General Technical Requirements

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

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

### 1.1 Summary of Results

#### FCC PART 15 Subpart E (Section 15.407: 5.15 - 5.35 GHz and 5.725 - 5.825 GHz bands)

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

**\*Refer to EMC Technologies' report M030949\_Ocampa\_Atheros\_5.2 SAR Report**

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.



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## 2.0 GENERAL INFORMATION

(Information supplied by the Client)

### 2.1 Product Details

|                             |                                    |
|-----------------------------|------------------------------------|
| <b>Test Sample:</b>         | Stylistic Pentablet PC             |
| <b>Model Number:</b>        | ST5010D                            |
| <b>Codename:</b>            | Ocampa                             |
| <b>Wireless LAN Module:</b> | Atheros                            |
| <b>Model Number:</b>        | WLL4030 (11a+b/g module)           |
| <b>Interface Type:</b>      | Mini-PCI WLAN Module               |
| <b>FCC ID:</b>              | EJE-WL0004                         |
| <b>Industry Canada ID:</b>  | 337J-WL0004                        |
| <b>Equipment Type:</b>      | Intentional Radiator (Transceiver) |

### 2.2 Test Sample Operational Description

The EUT is a Mini-PCI Wireless LAN (WLAN) Module (Atheros WLL4030) installed in Fujitsu's Stylistic Pentablet PC, Model ST5010D (Ocampa). The Atheros WLAN module is an OEM product from ASKEY Computer Corporation. The 'Atheros WLL4030' design is based on the Atheros AR5002X chipset, which implements IEEE 802.11a and IEEE 802.11b/IEEE802.11g WLAN solutions.

The manufacturer has previously certified this module as an OEM device.

This pre-certified Atheros module is installed in Fujitsu Tablet PC and has been tested again for FCC and Industry Canada compliance.

Refer to the following appendices:

Appendix B: Test sample & setup photographs

Appendix C: Functional description

Appendix G: WLAN specifications

This report details the IEEE 802.11a and IEEE 802.11b/IEEE 802.11g configurations.



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## 2.3 Technical Specifications

|                              |                                                                                                                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Modulation Type:</b>      | Direct Sequence Spread Spectrum (DSSS for 802.11b)<br>Orthogonal Frequency Division Multiplexing (OFDM for 802.11g)<br>Orthogonal Frequency Division Multiplexing (OFDM for 802.11a) |
| <b>802.11a</b>               | BPSK – 6Mbps, 9Mbps<br>QPSK – 12Mbps, 18Mbps<br>16QAM – 24Mbps, 36Mbps<br>64QAM – 48Mbps, 54Mbps                                                                                     |
| <b>802.11g</b>               | BPSK – 6Mbps, 9Mbps<br>QPSK – 12Mbps, 18Mbps<br>16QAM – 24Mbps, 36Mbps<br>64QAM – 48Mbps, 54Mbps                                                                                     |
| <b>802.11b</b>               | DBPSK – 1Mbps<br>DQPSK – 2Mbps<br>CCK – 5.5Mbps, 11Mbps                                                                                                                              |
| <b>Maximum Data Rate:</b>    | 802.11b = 11Mbps, 802.11g = 54 Mbps and 802.11a = 54Mbps                                                                                                                             |
| <b>Frequency Range:</b>      | 2.4 – 2.4835 GHz for 11b/g (operational range 2.412 – 2.462 GHz)<br>5.15 - 5.25 GHz, 5.25 – 5.35 GHz, 5.725 - 5.825 GHz for 11a                                                      |
| <b>Number of Channels:</b>   | 11 maximum (for 11b/11g)<br>12 maximum (for 11a) *Passive Scan only                                                                                                                  |
| <b>Antenna Types:</b>        | Monopole Ceramic Chip Antenna – YCE 5008                                                                                                                                             |
| <b>Max. Output Power:</b>    | 802.11b and 802.11g = 18 dBm<br>802.11a Band 1 (5.15 to 5.25 GHz) = 14 dBm<br>802.11a Band 2 (5.25 to 5.35 GHz) = 17 dBm<br>802.11a Band 3 (5.725 to 5.825 GHz) = 16 dBm             |
| <b>Power Supply:</b>         | 3.3 VDC from PCI bus                                                                                                                                                                 |
| <b>Chipset Used:</b>         | Atheros AR5212, AR5112                                                                                                                                                               |
| <b>Turbo Mode:</b>           | For 802.11g & 802.11a only                                                                                                                                                           |
| <b>Output Power (Turbo):</b> | 16 dBm                                                                                                                                                                               |
| <b>Data rate (Turbo):</b>    | 12 MBps to 108 Mbps                                                                                                                                                                  |

### 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                        |



**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            | --                                              |

**EUT Host Details:**

**Host PC:** STYLISTIC ST Series (Tablet PC)  
**Model Number:** ST5010D  
**Codename:** Ocampa  
**Serial Number:** Not supplied  
**Manufacturer:** Fujitsu Ltd

**CPU Type and Speed:** Banias ULV 1.0 GHz  
**SDRAM:** 256 MB  
**LCD Screen:** 12.1 "XGA  
**Hard Disk Drive:** 40 GB

**LAN:** Giga-LAN/10/100Base-T  
**Wireless LAN Module:** Atheros 11a+b/g  
**Docking Station Model:** FPCPR43xx (x: A-Z or blank)  
 FPCPR44xx (x: A-Z or blank)

**AC Adapter :**

| Volts | Adapter Spec |       | Model Number: | Alternate Model Number |
|-------|--------------|-------|---------------|------------------------|
|       | Amps         | Watts |               |                        |
| 16    | 3.75         | 60    | SEC80N2-16.0  | CP171180-01            |

**2.4 Test sample configuration**

The Atheros module supports IEEE 802.11a, IEEE 802.11b and IEEE 802.11g configurations. Tests were performed in all three configurations and all modulation types were investigated. The results for IEEE 802.11a configuration is reported. The results for IEEE 802.11b and IEEE 802.11g configurations are reported separately. Refer to EMC test report: M030949\_Certification\_Ocampa\_Atheros\_2.4.

**Antenna**

The Atheros WLAN (WLL4030 (11a+b/g)) is configured with a Monopole Ceramic Chip antenna (refer to Appendix O for Antenna specifications). The installation of the OEM WLAN module and the Antenna in Fujitsu STYLISTIC pentablet PC is in a controlled environment. The installation is performed during the production/assembly process at the Fujitsu factory.

**AC Adapter**

The AC adapter SEC80N2-16.0 was used for all the tests. This adapter is also identified as CP171180-01. The manufacturer has stated that all these adapters are identical electrically and mechanically.

Refer to Appendix B - Test Setup Photographs.



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## 2.5 Test Sample Block Diagram

Refer to Appendix D - EUT Block Diagram

## 2.6 Test Sample Support Equipment

### External Monitor/s:

Conducted EMI

Viewmaster, P/N CA64 150DL, S/N CN7610276

Radiated EMI

Hewlett Packard 15" Colour monitor, Model D2827A,  
FCC ID: C5F7NFCMC1515X

IR Keyboard:

P/N N860-7628-T152

IR Mouse:

M2W883Z013-02, S/N 0806256M01A

USB Scanner:

Rapidscan Mobile Colour scanner, M/N FPCSCN01, S/N DF1700100

USB Floppy Drive/s:

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

LAN Hub:

Kingston SOHO Hub Model: KNE8TB/H (FCC ID: JICKNE8TP-HO)

PCMCIA Slot:

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

Memory Card:

Secure Digital- 32 MB

AC Adapter:

SEC80N2-16.0

## 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).



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## 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. (dBμV).

### 2.9.2 Radiated Emissions

Measurements are reported in units of dB relative to one microvolt per metre (dBμV/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.



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## **RESULTS**

### **FCC PART 15 Subpart E**

#### **Section 15.407: General Technical Requirements**



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## 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 dB $\mu$ V to be compared to the limit.  
**VRx** = the Voltage in dB $\mu$ V 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 was 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)

| 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 |
|---------------|---------|------------------------------|---------------------|----------------------|------------------------------|---------------------|----------------------|
| 0.202         | Active  | 49.2                         | 63.5                | -14.3                | 30.5                         | 53.5                | -23.0                |
| 0.198         | Neutral | 49.3                         | 63.7                | -14.4                | 31.6                         | 53.7                | -22.1                |
| 0.154         | Neutral | 49.8                         | 65.8                | -16.0                | 23.7                         | 55.8                | -32.1                |
| 0.153         | Active  | 49.8                         | 65.8                | -16.0                | 22.5                         | 55.8                | -33.3                |
| 16.01         | Active  | 35.6                         | 60.0                | -24.4                | 29.2                         | 50.0                | -20.8                |
| 16.62         | Neutral | 33.5                         | 60.0                | -26.5                | 27.0                         | 50.0                | -23.0                |

All emissions complied with the Class B quasi peak and average limits by margins of greater than 10 dB. The measurement uncertainty was  $\pm 2.0$  dB.

Refer to Appendix J for plots of the conducted EMI measurements.



## 2.0 RADIATED EMISSION MEASUREMENTS

### 2.1 Test Procedure

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

Radiated emission measurements were performed to the limits as per section 15.209 and 15.407.

Testing was performed while the transmitter continuously transmitted. 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 40 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 measurement data for each frequency range was automatically corrected by the software for cable losses, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

### 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 dB $\mu$ V/m.

**V** = EMI Receiver Voltage in dB $\mu$ V. (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 dB $\mu$ V 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)  $\pm$  4.1 dB  
(30 MHz – 1,000 MHz)  $\pm$  3.7 dB



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

### 2.3.1 Frequency Band: 1 – 40 GHz

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

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

The peak limits for undesirable emission outside of the restricted bands are -27 dBm (68.3 dB $\mu$ V/m @ 3m), except emissions within 10MHz of operating frequency range of 5.725 – 5825 GHz are -17 dBm (78.3 dB $\mu$ V/m @ 3m).

Measurements were performed on two frequency bands (5.15 - 5.35 GHz and 5.725 - 5.825 GHz)

The field strength at 5825 MHz when the EUT was operating at its highest channel (5805 MHz), was 51.6 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 5150 MHz when the EUT was operating at its lowest channel (5180 MHz), was 50.8 dB $\mu$ V/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

#### 2.3.1.1 Configuration 802.11a - 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 9 Mbps (BPSK).

##### Channel 36 – 5180 MHz

| Frequency MHz | Level dB $\mu$ V/m |                  | Antenna Polarization | Peak Limit dB $\mu$ V/m | Average Limit dB $\mu$ V/m | Result |
|---------------|--------------------|------------------|----------------------|-------------------------|----------------------------|--------|
|               | Peak Detector      | Average Detector |                      |                         |                            |        |
| 5180          | Transmitter        | Fundamental      |                      |                         |                            |        |
| 10360         | 49.8               | 38.2             | Vert/Hort            | 68.3                    | -                          | Pass   |
| 15540         | 54.0               | 43.4             | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 20720         | 57.3               | 45.9             | Vert/Hort            | 84.0* (1m)              | 64.0* (1m)                 | Pass   |
| 25900         | 59.6               | 47.7             | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |
| 31080         | 68.1               | 56.5             | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |
| 36260         | 67.7               | 55.6             | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |

##### Channel 52 – 5260 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 |                      |                         |                            |        |
| 5260          | Transmitter        | Fundamental      |                      |                         |                            |        |
| 10520         | 49.9               | 38.5             | Vert/Hort            | 68.3                    | -                          | Pass   |
| 15780         | 53.8               | 43.8             | Vert/Hort            | 74.0                    | 54.0                       | Pass   |
| 21040         | 58.2               | 44.9             | Vert/Hort            | 84.0* (1m)              | 64.0* (1m)                 | Pass   |
| 26300         | 60.4               | 47.7             | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |
| 31560         | 68.6               | 53.9             | Vert/Hort            | 84.0* (1m)              | 64.0* (1m)                 | Pass   |
| 36820         | 68.3               | 55.4             | Vert/Hort            | 78.3* (1m)              | -                          | Pass   |



**Channel 64 – 5320 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5320          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 10640         | 50.3          | 39.1             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 15960         | 53.9          | 42.8             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 21280         | 56.6          | 45.4             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 26600         | 59.4          | 48.7             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 31920         | 67.8          | 57.2             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 37240         | 68.2          | 58.3             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

**Channel 149 – 5745 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5745          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 11490         | 51.4          | 39.7             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 17235         | 54.6          | 42.2             | Vert/Hort            | 68.3              | -                    | Pass   |
| 22980         | 60.7          | 50.0             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 28725         | 67.8          | 57.3             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 34470         | 68.0          | 68.5             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

**Channel 157 – 5785 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5785          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 11570         | 52.3          | 39.4             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 17355         | 55.0          | 43.1             | Vert/Hort            | 68.3              | -                    | Pass   |
| 23140         | 59.6          | 48.7             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 28925         | 67.7          | 57.7             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 34710         | 67.4          | 67.6             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |



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**Channel 161 – 5805 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5805          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 11610         | 51.7          | 40.2             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 17415         | 55.4          | 42.7             | Vert/Hort            | 68.3              | -                    | Pass   |
| 23220         | 60.3          | 48.5             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 29025         | 68.3          | 56.9             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 34830         | 68.3          | 67.1             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

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

Harmonics were recorded within the restricted bands of up to 40 GHz and complied with the FCC Class B limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209 and 15.407. The measurement uncertainty for radiated emissions in this band was  $\pm 4.1$  dB.

**Result:** Complies

**2.3.1.2 Configuration 802.11a – Turbo Operating Mode**

Testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (Turbo).

**Channel 36 – 5210 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5210          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 10420         | 50.2          | 38.7             | Vert/Hort            | 68.3              | -                    | Pass   |
| 15630         | 53.8          | 43.1             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 20840         | 56.7          | 46.6             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 26050         | 61.4          | 48.9             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 31260         | 68.9          | 57.2             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 36470         | 68.5          | 57.3             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |

**Channel 48 – 5250 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5250          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 10500         | 50.1          | 39.5             | Vert/Hort            | 68.3              | -                    | Pass   |
| 15750         | 52.9          | 43.0             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 21000         | 55.5          | 46.2             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 26250         | 61.2          | 49.0             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 31500         | 69.0          | 57.8             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 36750         | 67.6          | 57.1             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

**Channel 56 – 5290 MHz**

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| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5290          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 10580         | 51.1          | 39.3             | Vert/Hort            | 68.3              | -                    | Pass   |
| 15870         | 53.9          | 43.1             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 21160         | 55.6          | 46.0             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 26450         | 61.8          | 48.8             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 31740         | 68.8          | 58.3             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 37030         | 68.2          | 58.1             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

**Channel 153 – 5760 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5760          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 11520         | 50.7          | 39.7             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 17280         | 52.7          | 43.0             | Vert/Hort            | 68.3              | -                    | Pass   |
| 23040         | 55.9          | 46.1             | Vert/Hort            | 84.0* (1m)        | 64.0* (1m)           | Pass   |
| 28800         | 62.3          | 49.7             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 34560         | 68.3          | 58.3             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

**Channel 161 – 5800 MHz**

| Frequency MHz | Level dBuV/m  |                  | Antenna Polarization | Peak Limit dBuV/m | Average Limit dBuV/m | Result |
|---------------|---------------|------------------|----------------------|-------------------|----------------------|--------|
|               | Peak Detector | Average Detector |                      |                   |                      |        |
| 5800          | Transmitter   | Fundamental      |                      |                   |                      |        |
| 11600         | 50.2          | 38.9             | Vert/Hort            | 74.0              | 54.0                 | Pass   |
| 17400         | 52.7          | 41.6             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 23200         | 56.5          | 45.8             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 29000         | 61.9          | 48.8             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |
| 34800         | 68.0          | 57.5             | Vert/Hort            | 78.3* (1m)        | -                    | Pass   |

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

Harmonics were recorded within the restricted bands of up to 40 GHz and complied with the FCC Class B limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209 and 15.407. The measurement uncertainty for radiated emissions in this band was  $\pm 4.1$  dB. Refer to tables above for results.

**Result:** Complies



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

Testing was performed at a distance of 10 metres.

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 on channel 36, 5180 MHz normal operating mode with the modulation rate of 54 Mbps (64QAM).

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

**Vertical Polarity**

| Frequency MHz | Polarisation | QP Measured dB $\mu$ V/m | QP Limit dB $\mu$ V/m | $\Delta$ QP $\pm$ dB |
|---------------|--------------|--------------------------|-----------------------|----------------------|
| 199.99        | Vertical     | 29.3                     | 33.5                  | -4.2                 |
| 202.92        | Vertical     | 28.6                     | 33.5                  | -4.9                 |
| 237.30        | Vertical     | 30.6                     | 36.0                  | -5.4                 |
| 197.38        | Vertical     | 27.2                     | 33.5                  | -6.3                 |
| 199.64        | Vertical     | 27.1                     | 33.5                  | -6.4                 |
| 197.25        | Vertical     | 26.6                     | 33.5                  | -6.9                 |
| 130.95        | Vertical     | 25.8                     | 33.5                  | -7.7                 |
| 132.92        | Vertical     | 25.5                     | 33.5                  | -8.0                 |
| 128.55        | Vertical     | 25.2                     | 33.5                  | -8.3                 |
| 266.45        | Vertical     | 27.4                     | 36.0                  | -8.6                 |
| 666.35        | Vertical     | 26.9                     | 36.0                  | -9.1                 |
| 262.32        | Vertical     | 26.6                     | 36.0                  | -9.4                 |
| 122.47        | Vertical     | 21.9                     | 33.5                  | -11.6                |
| 74.79         | Vertical     | 15.1                     | 30.0                  | -14.9                |
| 295.37        | Vertical     | 20.9                     | 36.0                  | -15.1                |
| 86.94         | Vertical     | 14.6                     | 30.0                  | -15.4                |

**Horizontal Polarity**

| Frequency MHz | Polarisation | QP Measured dB $\mu$ V/m | QP Limit dB $\mu$ V/m | $\Delta$ QP $\pm$ dB |
|---------------|--------------|--------------------------|-----------------------|----------------------|
| 266.46        | Horizontal   | 34.3                     | 36.0                  | -1.7                 |
| 197.23        | Horizontal   | 26.5                     | 33.5                  | -7.0                 |
| 696.19        | Horizontal   | 27.2                     | 36.0                  | -8.8                 |
| 199.00        | Horizontal   | 24.3                     | 33.5                  | -9.2                 |
| 202.89        | Horizontal   | 23.4                     | 33.5                  | -10.1                |
| 199.57        | Horizontal   | 23.2                     | 33.5                  | -10.3                |
| 275.05        | Horizontal   | 24.4                     | 36.0                  | -11.6                |
| 663.20        | Horizontal   | 23.9                     | 36.0                  | -12.1                |
| 115.00        | Horizontal   | 20.8                     | 33.5                  | -12.7                |
| 288.01        | Horizontal   | 21.2                     | 36.0                  | -14.8                |
| 263.49        | Horizontal   | 19.6                     | 36.0                  | -16.4                |
| 250.18        | Horizontal   | 17.9                     | 36.0                  | -18.1                |
| 82.11         | Horizontal   | 10.4                     | 30.0                  | -19.6                |
| 91.49         | Horizontal   | 12.2                     | 33.5                  | -21.3                |

The highest radiated emission peak occurred at 266.46 MHz (Horizontal polarity) and complied with FCC quasi peak limit by a margin of 1.7 dB. The measurement uncertainty in this band was  $\pm 3.7$  dB. Refer to tables above for results.

**Result:** Complies.



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### 2.3.3 Band Edge Measurements

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

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

Testing was performed while transmitter continuously transmitted on a low and high frequency channel of two frequency bands (5.150 – 5.350 GHz and 5.725 – 5.825 GHz)

#### 2.3.3.1 Configuration 802.11a - Normal Operating Mode

##### Band1: 5.150 – 5.350 GHz

Refer to Appendix L for Band Edge plots

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

##### Band2: 5.725 – 5.825 GHz

Refer to Appendix L for Band Edge plots

*NB:* D1 indicates the limit line for undesirable emission frequencies within 10 MHz above or below the band edge of the operation frequency band.

D2 indicates the limit line for undesirable emission frequencies 10 MHz or greater above or below the band edge of the operation frequency band.

#### 2.3.3.2 Configuration 802.11a - Turbo Operating Mode

##### Band1: 5.150 – 5.350 GHz

Refer to Appendix L for Band Edge plots

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

##### Band2: 5.725 – 5.825 GHz

Refer to Appendix L for Band Edge plots

*NB:* D1 indicates the limit line for undesirable emission frequencies within 10 MHz above or below the band edge of the operation frequency band.

D2 indicates the limit line for undesirable emission frequencies 10 MHz or greater above or below the band edge of the operation frequency band.

**Result:** Complies.



### 3.0 Peak Transmit Power - Section 15.407 (a)

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

Measurements were performed while the transmitter continuously transmitted.

The average output power (A in dBm) of the transmitter was measured with a calibrated RF power meter and a power sensor.

The e.i.r.p (P) was calculated as follows:

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

Measurements were performed on two frequency bands (5.150 – 5.350 GHz and 5.725 – 5.825 GHz)

### 3.1 Configuration 802.11a – Normal Operating Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Peak power with BPSK modulation (rate = 9 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 9 Mbps (BPSK). The target output power was set to 16 dBm for frequency 5180 MHz and 18 dBm for all other frequencies.

| Frequency MHz | A dBm | Coax Loss dB | G dBi | P dBm | Limit dBm | P mW | Limit mW |
|---------------|-------|--------------|-------|-------|-----------|------|----------|
| 5180          | 14.6  | 0.5          | 0.69  | 15.8  | 17        | 38.0 | 50       |
| 5260          | 16.2  | 0.5          | 0.69  | 17.4  | 24        | 55.0 | 250      |
| 5320          | 15.2  | 0.5          | 0.69  | 16.4  | 24        | 43.7 | 250      |
| 5745          | 13.8  | 0.5          | 0.69  | 15.0  | 30        | 31.6 | 1000     |
| 5785          | 13.6  | 0.5          | 0.69  | 14.8  | 30        | 30.2 | 1000     |
| 5805          | 13.7  | 0.5          | 0.69  | 14.9  | 30        | 30.9 | 1000     |

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

**Result:** Complies.

### 3.2 Configuration 802.11a – Turbo Operating Mode

Testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (Turbo). The target output power was set to 16 dBm for frequencies 5210 MHz and 5250 MHz and 18 dBm for all other frequencies.

| Frequency MHz | A dBm | Coax Loss dB | G dBi | P dBm | Limit dBm | P mW | Limit mW |
|---------------|-------|--------------|-------|-------|-----------|------|----------|
| 5210          | 14.3  | 0.5          | 0.69  | 15.5  | 17        | 35.5 | 50       |
| 5250          | 14.1  | 0.5          | 0.69  | 15.3  | 17        | 33.9 | 250      |
| 5290          | 16.3  | 0.5          | 0.69  | 17.5  | 24        | 56.2 | 250      |
| 5760          | 14.0  | 0.5          | 0.69  | 15.2  | 30        | 33.1 | 1000     |
| 5800          | 13.8  | 0.5          | 0.69  | 15.0  | 30        | 31.6 | 1000     |

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

**Result:** Complies.



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#### 4.0 Channel Bandwidth

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

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

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

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

Measurements were performed on two frequency bands (5.150 – 5.350 GHz and 5.725 – 5.825 GHz)

#### 4.1 Configuration 802.11a – 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 9 Mbps (BPSK).

| Channel | Frequency MHz | Bandwidth MHz | 26 dB Bandwidth Plots |
|---------|---------------|---------------|-----------------------|
| 36      | 5180          | 39.48         | Appendix K            |
| 52      | 5260          | 37.37         | Appendix K            |
| 64      | 5320          | 34.77         | Appendix K            |
| 149     | 5745          | 37.47         | Appendix K            |
| 157     | 5785          | 33.07         | Appendix K            |
| 161     | 5805          | 33.07         | Appendix K            |

#### 4.2 Configuration 802.11a – Turbo Operating Mode

Testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (Turbo).

| Channel | Frequency MHz | Bandwidth MHz | 26 dB Bandwidth Plots |
|---------|---------------|---------------|-----------------------|
| 36      | 5210          | 104.85        | Appendix K            |
| 48      | 5250          | 106.16        | Appendix K            |
| 56      | 5290          | 107.04        | Appendix K            |
| 153     | 5760          | 46.29         | Appendix K            |
| 161     | 5800          | 46.89         | Appendix K            |



## 5.0 Radio Frequency Exposure (Hazard) Information

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

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

In accordance with this section and also section 2.1091 this device has been defined as a portable device whereby a distance of 20 cm normally cannot 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>.

The maximum distance from the antenna at which the MPE is met or exceeded has been calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain and separation distance in metres:

$$E, \text{ V/m} = (\sqrt{30 * P * G}) / d$$

$$\text{Power density, mW/cm}^2 = E^2 / 3770$$

$$E \text{ for MPE: } = \sqrt{E^2 / 3770}$$

$$E = \sqrt{1 * 3770}$$

$$E = 61.4 \text{ V/m}$$

The max Antenna (Monopole Ceramic Chip) gain = 0.69 dBi

### Conducted Power

Highest output power was calculated. The result was extracted from section 3.0 of this report.

| Frequency MHz | Operating Mode | Modulation     | Maximum Conducted Output Power Measured |
|---------------|----------------|----------------|-----------------------------------------|
| 5260          | Normal         | OFDM (802.11a) | 17.4 dBm (55.0mW)                       |
| 5290          | Turbo          | OFDM (802.11a) | 17.5 dBm (56.2mW)                       |

The total power (P\*G) measured at the Antenna of WLAN Module (Atheros, WLL4030-Ocampa)

The maximum transmitter power measured (normal mode) = 17.4 dBm or 55.0 milliwatts.

$$d = \sqrt{(30 * P * G) / E}$$

$$= \sqrt{(30 * 0.055) / 61.4}$$

$$= 0.0209 \text{ metres or } 2.09 \text{ cm}$$

The maximum transmitter power measured (turbo mode) = 17.5 dBm or 56.2 milliwatts.

$$d = \sqrt{(30 * P * G) / E}$$

$$= \sqrt{(30 * 0.0562) / 61.4}$$

$$= 0.0211 \text{ metres or } 2.11 \text{ cm}$$

### Conclusion:

Calculations show that this device with described antenna does not meet the MPE requirements for portable devices falling below the 20 cm clearance required, however the SAR value of 1.29 mW/g complies with the FCC human exposure requirements of 47 CFR 2.1093 (d).

Refer to EMC Technologies' report - M030949\_Ocampa\_Atheros\_5.2 SAR Report for details of SAR compliance.



## 6.0 Peak Power Spectral Density - Section 15.407 (a)

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

The peak transmit power was measured over an interval of continuous transmission using a calibrated spectrum analyser with the resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz.

The transmitter output was connected to the spectrum analyser with a span setting to capture the entire emission bandwidth of the signal. The peak transmit power was recorded in dBm.

Measurements were performed on two frequency bands (5.150 – 5.350 GHz and 5.725 – 5.825 GHz)

### 6.1 Configuration 802.11a – Normal Operating Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Peak power spectral density with BPSK modulation (rate = 9 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 9 Mbps (BPSK). The target output power was set to 16 dBm for frequency 5180 MHz and 18 dBm for all other frequencies.

| Channel | Frequency MHz | Peak Transmit Power (dBm) | Limit (dBm) | Result   | Spectral Density plots |
|---------|---------------|---------------------------|-------------|----------|------------------------|
| 36      | 5180          | 1.70                      | 4.0         | Complies | Appendix M             |
| 52      | 5260          | 3.08                      | 11.0        | Complies | Appendix M             |
| 64      | 5320          | 2.67                      | 11.0        | Complies | Appendix M             |
| 149     | 5745          | 1.52                      | 17.0        | Complies | Appendix M             |
| 157     | 5785          | 0.64                      | 17.0        | Complies | Appendix M             |
| 161     | 5805          | 0.71                      | 17.0        | Complies | Appendix M             |

**Result:** Complies.

### 6.2 Configuration 802.11a – Turbo Operating Mode

Testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (Turbo). The target output power was set to 16 dBm for frequency 5210 MHz and 18 dBm for all other frequencies.

| Channel | Frequency MHz | Peak Transmit Power (dBm) | Limit (dBm) | Result   | Spectral Density plots |
|---------|---------------|---------------------------|-------------|----------|------------------------|
| 36      | 5210          | 1.14                      | 4.0         | Complies | Appendix M             |
| 48      | 5250          | 2.16                      | 4.0         | Complies | Appendix M             |
| 56      | 5290          | 1.97                      | 11.0        | Complies | Appendix M             |
| 153     | 5760          | -0.15                     | 17.0        | Complies | Appendix M             |
| 161     | 5800          | -1.11                     | 17.0        | Complies | Appendix M             |

**Result:** Complies.



## 7.0 Peak Power Excursion - Section 15.407 (a)

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

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

The peak transmit power was measured over an interval of continuous transmission using a calibrated spectrum analyser with the resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz for Trace 1 and video bandwidth of 300 kHz for Trace 2. The difference between Trace 1 and Trace 2 was recorded.

Measurements were performed on two frequency bands (5.150 – 5.350 GHz and 5.725 – 5.825 GHz)

## 7.1 Configuration 802.11a – Normal Operating Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in peak excursion were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 9 Mbps (BPSK).

| Channel | Frequency MHz | Peak Power Excursion (dB) | Limit (dB) | Result   | Spectral Density plots |
|---------|---------------|---------------------------|------------|----------|------------------------|
| 36      | 5180          | 4.17                      | 13.0       | Complies | Appendix N             |
| 52      | 5260          | 4.24                      | 13.0       | Complies | Appendix N             |
| 64      | 5320          | 3.64                      | 13.0       | Complies | Appendix N             |
| 149     | 5745          | 4.16                      | 13.0       | Complies | Appendix N             |
| 157     | 5785          | 3.03                      | 13.0       | Complies | Appendix N             |
| 161     | 5805          | 2.76                      | 13.0       | Complies | Appendix N             |

**Result:** Complies.

## 7.2 Configuration 802.11a – Turbo Operating Mode

Testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (Turbo).

| Channel | Frequency MHz | Peak Power Excursion (dB) | Limit (dB) | Result   | Spectral Density plots |
|---------|---------------|---------------------------|------------|----------|------------------------|
| 36      | 5210          | 4.18                      | 13.0       | Complies | Appendix N             |
| 48      | 5250          | 3.73                      | 13.0       | Complies | Appendix N             |
| 56      | 5290          | 3.27                      | 13.0       | Complies | Appendix N             |
| 153     | 5760          | 3.04                      | 13.0       | Complies | Appendix N             |
| 161     | 5800          | 3.77                      | 13.0       | Complies | Appendix N             |

**Result:** Complies.



## 8.0 Frequency Stability

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

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

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

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

Measurements were performed on two frequency bands (5.150 – 5.350 GHz and 5.725 – 5.825 GHz)

### 8.1 Configuration 802.11a – Normal Operating Mode

Testing was performed while the transmitter continuously operated with the modulation rate of 9 Mbps (BPSK).

| Channel | Frequency MHz | Maximum Frequency Deviation kHz | Maximum Deviation % | $\pm 0.02\%$ Limit kHz | Result   |
|---------|---------------|---------------------------------|---------------------|------------------------|----------|
| 36      | 5180          | 322                             | 0.00622             | 1036                   | Complies |
| 52      | 5260          | 359                             | 0.00683             | 1052                   | Complies |
| 64      | 5320          | 365                             | 0.00686             | 1064                   | Complies |
| 149     | 5745          | 418                             | 0.00728             | 1149                   | Complies |
| 157     | 5785          | 503                             | 0.00869             | 1157                   | Complies |
| 161     | 5805          | 517                             | 0.00891             | 1161                   | Complies |

**Result:** Complies.

### 8.2 Configuration 802.11a – Turbo Operating Mode

Testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (Turbo).

| Channel | Frequency MHz | Maximum Frequency Deviation kHz | Maximum Deviation % | $\pm 0.02\%$ Limit kHz | Result   |
|---------|---------------|---------------------------------|---------------------|------------------------|----------|
| 36      | 5210          | 327                             | 0.00628             | 1042                   | Complies |
| 48      | 5250          | 355                             | 0.00676             | 1050                   | Complies |
| 56      | 5290          | 381                             | 0.00720             | 1058                   | Complies |
| 153     | 5760          | 416                             | 0.00722             | 1152                   | Complies |
| 161     | 5800          | 462                             | 0.00797             | 1160                   | Complies |

**Result:** Complies.

## 9.0. 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.



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## 10.0 COMPLIANCE STATEMENT

The Mini-PCI Wireless LAN Module (Atheros), Model WLL4030 installed in Fujitsu Stylistic Pentablen PC, Model ST5010D (Ocampa), tested on behalf of Fujitsu Australia Ltd, **complies** with the requirements of 47 CFR, Part 15 Subpart E -Section 15.407 (5.15-5.35 GHz and 5.725-5.825 GHz bands).

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

Results were as follows:

### FCC PART 15 Subpart E (Section 15.407: 5.15 - 5.35 GHz and 5.725 - 5.825 GHz bands)

| 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 Power Excursion              | Complies                        |
| 15.407 (b)                     | 6.2.2(q1)                       | Undesirable Emission              | Complies                        |
| 15.407 (f)                     |                                 | Radio Frequency Hazard            | *Complies with SAR requirements |
| 15.407 (g)                     | 6.4                             | Frequency Stability               | Complies                        |

\*Refer to EMC Technologies' report M030949\_Ocampa\_Atheros\_5.2 SAR Report



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## 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 8546A Sn.3549A00290 EMI Receiver                                                               | 13/03/03              | 13/03/04             | 1 YEAR *2        |
| EMI RECEIVER             | HP 8574B System Components                                                                        | 12/02/03              | 12/02/04             | 1 YEAR *2        |
| EMI RECEIVER             | HP8593EM, SN3146A-01297<br>9 kHz – 26 GHz                                                         | 13/06/03              | 13/06/04             | 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        |
| 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        |
| ENVIRONMENTAL<br>CHAMBER | Heraeus votsch, Type: HT 4033<br>Order number: 60884376<br>Temperature range: -40 to +180 degrees | -----                 | -----                | -----            |
| POWER METER              | HP 437B                                                                                           | 24/05/03              | 24/05/04             | 1 YEAR *2        |
| POWER SENSOR             | HP8481H                                                                                           | 04/06/03              | 04/06/04             | 1 YEAR *2        |

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<br>Lerderberg Gorge, near Bacchus Marsh,<br>Victoria)   | 21/01/03                    | 21/01/04                    | 1 Year *1                      |

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



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## **TEST REPORT APPENDICES**

**(Submitted as attachments)**

**APPENDIX B: REPORT PHOTOGRAPHS**

**B1: Test Sample**

**B2: Test Setup**

**B3: WLAN & Antenna Location**

**APPENDIX C: FUNCTIONAL DESCRIPTION**

**APPENDIX D: BLOCK DIAGRAM**

**APPENDIX E: TEST SAMPLE SCHEMATICS**

**APPENDIX F: PCB LAYOUTS**

**APPENDIX G: EUT (WLAN) SPECIFICATIONS**

**APPENDIX H: EUT (WLAN) BILL OF MATERIALS**

**APPENDIX I: FCC LABELLING DETAILS**

**APPENDIX J: GRAPHS of EMI MEASUREMENTS**

**APPENDIX K: CHANNEL BANDWIDTH PLOTS**

**APPENDIX L: BANDEDGE PLOTS**

**APPENDIX M: PEAK POWER SPECTRAL DENSITY PLOTS**

**APPENDIX N: PEAK POWER EXCURSION PLOTS**

**APPENDIX O: ANTENNA INFORMATION (MONOPOLE CERAMIC CHIP ANTENNA)**

**APPENDIX P: EUT USER MANUAL**

