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

FCC ID:	**EJE-WL0004**
Industry Canada ID:	**337J-WL0004**
Test Sample:	Stylistic Pentablet PC
Model Number:	ST5010D
Codename:	Ocampa
Wireless LAN Module:	Atheros
Model Number:	WLL4030 (11a+b/g module)
Tested for:	Fujitsu Australia Ltd.
Issue Date:	18th December 2003

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. M030949_Certification_Ocampa_Atheros_2.4

Issue Date: 18th December 2003

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Report Number:	M030949_Certification_Ocampa_Atheros_2.4
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 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:	4th – 20th October 2003
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 Signature:	**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

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 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, 5725-5815 MHz

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 C - Section 15.247.

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) and the RF exposure requirements of RSS-102.

1.1 Summary of Results

FCC PART 15 Subpart C (Section 15.247: 2400 - 2483.5 MHz band)

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 with SAR requirements**
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	**Complies**
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	**Complies**

***Refer to EMC Technologies' report M030949_Ocampa_Atheros_2.4 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.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

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

2.3 Technical Specifications

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 = 54 Mbps and 802.11a = 54Mbps
Frequency Range:	2.4 –2.4835 GHz for 11b/g (operational range 2.412 – 2.462 GHz) 5.15 - 5.25 GHz, 5.25 – 5.35 GHz, 5.725 - 5.825 GHz for 11a
Number of Channels:	11 maximum (for 11b/11g) 12 maximum (for 11a) *Passive Scan only
Antenna Types:	Monopole Ceramic Chip Antenna – YCE 5008
Max. Output Power:	802.11b and 802.11g = 18 dBm 802.11a Band 1 (5.15 to 5.25 GHz) = 14 dBm 802.11a Band 2 (5.25 to 5.35 GHz) = 17 dBm 802.11a Band 3 (5.725 to 5.825 GHz) = 16 dBm
Power Supply:	3.3 VDC from PCI bus
Chipset Used:	Atheros AR5212, AR5112
Turbo Mode:	For 802.11g & 802.11a only
Output Power (Turbo):	16 dBm
Data rate (Turbo):	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): 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 :

Adapter Spec			Model Number:	Alternate Model Number
Volts	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 802.11b and IEEE 802.11g configurations are reported. The results for IEEE 802.11a are reported separately. Refer to EMC test report: M030949_Certification_Ocampa_Atheros_5.2.

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.

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 5th 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
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^2LA).

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.

RESULTS

FCC PART 15 Subpart C

Section 15.247: 2400 - 2483.5 MHz band

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)

Frequency MHz	Line	Measured QP Level dBµV	QP Limit dBµV	ΔQP ±dB	Measured AV Level dBµV	AV Limit dBµV	ΔAV ±dB
0.201	Active	50.3	63.6	-13.3	33.8	53.6	-19.8
0.163	Active	50.6	65.3	-14.7	35.1	55.3	-20.2
0.201	Neutral	47.8	63.6	-15.8	32.2	53.6	-21.4
0.158	Neutral	48.3	65.6	-17.3	30.5	55.6	-25.1
0.306	Active	39.6	60.1	-20.5	22.3	50.1	-27.8
0.240	Neutral	39.7	62.1	-22.4	23.3	52.1	-28.8
0.299	Neutral	37.6	60.3	-22.7	24.2	50.3	-26.1
11.51	Active	32.0	60.0	-28.0	21.6	50.0	-28.4
11.90	Neutral	29.2	60.0	-30.8	20.9	50.0	-29.1

All emissions complied with the Class B quasi peak and average limits by margins of greater than 10 dB. The measurement uncertainty was ±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 15.247(c).

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

Testing was performed while the transmitter continuously transmitted on a low, middle and high frequency channel. 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^{-1}). (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 dBμV/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 dBμV/m limit at 3 metres has been converted to 64 dBμV/m at 1 metre using a factor of 20 dB per decade where emissions were located in the restricted bands.

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2462 MHz), was 42.8 dBμV/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 42.0 dBμV/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

Measurements 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 dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2412	Transmitter	Fundamental				
4824	49.3	37.1	Vert/Hort	74.0	54.0	Pass
7236	55.1	43.5	Vert/Hort	-	-	Pass
9648	48.8	38.8	Vert/Hort	-	-	Pass
12060	52.5	41.6	Vert/Hort	74.0	54.0	Pass
14472	53.7	42.9	Vert/Hort	74.0	54.0	Pass
16884	54.2	43.9	Vert/Hort	-	-	Pass
19296	57.0	46.7	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	61.6	50.4	Vert/Hort	-	-	Pass
24120	60.1	50.2	Vert/Hort	-	-	Pass

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	48.4	38.0	Vert/Hort	74.0	54.0	Pass
7311	54.5	43.7	Vert/Hort	74.0	54.0	Pass
9748	49.1	38.6	Vert/Hort	-	-	Pass
12185	51.9	40.8	Vert/Hort	74.0	54.0	Pass
14622	52.9	43.1	Vert/Hort	-	-	Pass
17059	54.5	43.9	Vert/Hort	-	-	Pass
19496	56.8	47.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	60.9	51.1	Vert/Hort	-	-	Pass
24370	59.7	50.2	Vert/Hort	-	-	Pass

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	49.1	37.7	Vert/Hort	74.0	54.0	Pass
7386	55.1	44.4	Vert/Hort	74.0	54.0	Pass
9848	48.8	37.6	Vert/Hort	-	-	Pass
12310	52.2	41.3	Vert/Hort	74.0	54.0	Pass
14772	53.5	43.5	Vert/Hort	-	-	Pass
17234	54.2	44.1	Vert/Hort	-	-	Pass
19696	56.4	47.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	61.1	50.9	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	60.7	49.6	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 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 ±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 9 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	49.2	37.7	Vert/Hort	74.0	54.0	Pass
7236	52.7	43.5	Vert/Hort	-	-	Pass
9648	49.4	38.2	Vert/Hort	-	-	Pass
12060	52.3	41.6	Vert/Hort	74.0	54.0	Pass
14472	53.7	42.9	Vert/Hort	74.0	54.0	Pass
16884	54.9	43.5	Vert/Hort	-	-	Pass
19296	57.6	46.6	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	60.3	49.4	Vert/Hort	-	-	Pass
24120	60.8	49.4	Vert/Hort	-	-	Pass

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	48.7	37.4	Vert/Hort	74.0	54.0	Pass
7311	53.1	43.9	Vert/Hort	74.0	54.0	Pass
9748	50.1	38.6	Vert/Hort	-	-	Pass
12185	51.9	40.8	Vert/Hort	74.0	54.0	Pass
14622	53.3	43.4	Vert/Hort	-	-	Pass
17059	54.5	44.8	Vert/Hort	-	-	Pass
19496	56.8	47.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	60.6	50.9	Vert/Hort	-	-	Pass
24370	60.4	50.5	Vert/Hort	-	-	Pass

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	49.0	37.1	Vert/Hort	74.0	54.0	Pass
7386	52.4	43.5	Vert/Hort	74.0	54.0	Pass
9848	49.9	39.7	Vert/Hort	-	-	Pass
12310	51.7	40.3	Vert/Hort	74.0	54.0	Pass
14772	53.6	42.2	Vert/Hort	-	-	Pass
17234	55.0	43.8	Vert/Hort	-	-	Pass
19696	57.7	46.7	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	61.2	49.6	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	61.3	50.4	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 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 ±4.1 dB.

Result: Complies

2.3.1.3 Configuration 802.11g – Turbo Operating Mode

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

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	48.4	35.6	Vert/Hort	74.0	54.0	Pass
7311	52.9	40.9	Vert/Hort	74.0	54.0	Pass
9748	49.1	38.2	Vert/Hort	-	-	Pass
12185	51.3	40.7	Vert/Hort	74.0	54.0	Pass
14622	53.6	42.5	Vert/Hort	-	-	Pass
17059	53.8	52.8	Vert/Hort	-	-	Pass
19496	55.9	45.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	60.0	49.1	Vert/Hort	-	-	Pass
24370	59.7	48.3	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 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 ±4.1 dB.

Result: Complies

2.3.2 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres.

Initial investigations were performed with 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 transmitter continuously operated with configuration 802.11g on the low (Channel 1, 2412 MHz) frequency channel 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 dBμV/m	QP Limit dBμV/m	ΔQP ± dB
499.94	Vertical	32.2	36.0	-3.8
198.99	Vertical	29.1	33.5	-4.4
200.01	Vertical	28.8	33.5	-4.7
232.11	Vertical	31.3	36.0	-4.7
699.94	Vertical	31.0	36.0	-5.0
199.18	Vertical	27.9	33.5	-5.6
127.69	Vertical	27.1	33.5	-6.4
203.36	Vertical	27.0	33.5	-6.5
331.82	Vertical	29.4	36.0	-6.6
327.18	Vertical	29.1	36.0	-6.9
129.33	Vertical	26.2	33.5	-7.3
198.06	Vertical	26.1	33.5	-7.4
126.15	Vertical	25.8	33.5	-7.7
300.06	Vertical	28.0	36.0	-8.0
400.01	Vertical	27.6	36.0	-8.4
75.02	Vertical	18.7	30.0	-11.3

Horizontal Polarity

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
699.94	Horizontal	32.7	36.0	-3.3
499.96	Horizontal	29.0	36.0	-7.0
399.99	Horizontal	27.8	36.0	-8.2
599.97	Horizontal	27.5	36.0	-8.5
200.05	Horizontal	23.5	33.5	-10.0
198.88	Horizontal	23.1	33.5	-10.4
327.22	Horizontal	25.3	36.0	-10.7
265.29	Horizontal	24.8	36.0	-11.2
198.25	Horizontal	22.0	33.5	-11.5
132.79	Horizontal	21.5	33.5	-12.0
130.90	Horizontal	21.3	33.5	-12.2
200.94	Horizontal	21.2	33.5	-12.3
334.11	Horizontal	22.9	36.0	-13.1
90.30	Horizontal	17.0	33.5	-16.5
86.82	Horizontal	12.9	30.0	-17.1
126.03	Horizontal	15.6	33.5	-17.9

The highest radiated emission peak occurred at 699.94 MHz (Horizontal polarity) and complied with FCC quasi peak limit by a margin of 3.3 dB. The measurement uncertainty in this band was ± 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 transmitter continuously transmitted on a low and high frequency 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 Configuration 802.11b

Refer to Appendix L1 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 Configuration 802.11g

Refer to Appendix L2 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 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 where G is the antenna gain in dBi & C is the cable loss

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). No significant differences in power were observed. Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK).

Frequency MHz	A dBm	Coax Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
2412	16.7	0.5	0.69	17.89	30	61.5	1000
2437	16.7	0.5	0.69	17.89	30	61.5	1000
2462	16.6	0.5	0.69	17.79	30	60.1	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 = 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).

Frequency MHz	A dBm	Coax Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
2412	16.8	0.5	0.69	17.99	30	63.0	1000
2437	16.9	0.5	0.69	18.09	30	64.4	1000
2462	16.7	0.5	0.69	17.89	30	61.5	1000

The specification limit is 1W (30 dBm).
Result: Complies

3.3 Configuration 802.11g - Turbo Operating Mode

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

Frequency MHz	A dBm	Coax Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
2437	16.9	0.5	0.69	18.09	30	64.4	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	11.46	Complies	Appendix K1
2437.0	11.46	Complies	Appendix K1
2462.0	11.50	Complies	Appendix K1

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 9 Mbps (BPSK).

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
2412.0	16.55	Complies	Appendix K2
2437.0	16.47	Complies	Appendix K2
2462.0	15.55	Complies	Appendix K2

The minimum 6 dB bandwidth is at least 500 kHz
Result: Complies

4.3 Configuration 802.11g - Turbo Operating Mode

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

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
2437.0	33.07	Complies	Appendix K2

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 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^2.

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, V/m = (√ (30 * P *G)) / d
Power density, mW/cm^2 = E^2/3770
E for MPE: = E^2/3770
E = √1*3770
E = 61.4 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	Modulation	Maximum Conducted Output Power Measured
2437	DSSS (802.11b)	17.89 dBm (61.5mW)
2437	OFDM (802.11g)	18.09 dBm (64.4mW)

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

The maximum transmitter power measured (DSSS) = 17.89 dBm or 61.5 milliwatts.
d = √ (30 * P *G) / E
= √ (30 * 0.0615) / 61.4
= 0.0221 metres or 2.21cm

The maximum transmitter power measured (OFDM) = 18.09 dBm or 64.4 milliwatts.
d = √ (30 * P *G) / E
= √ (30 * 0.0644) / 61.4
= 0.0226 metres or 2.26cm

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 1.03 mW/g complies with the FCC human exposure requirements of 47 CFR 2.1093 (d).
Refer to EMC Technologies' report - M030949_Ocampa_Atheros_2.4 SAR Report for details of SAR compliance.

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	-5.45	8.0	Complies	Appendix M1
2437.0	-4.95	8.0	Complies	Appendix M1
2462.0	-4.79	8.0	Complies	Appendix M1

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). 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).

Frequency Hz	Level dBm	Limit dBm	Result	Spectral Density plots
2412.0	-8.22	8.0	Complies	Appendix M2
2437.0	-9.24	8.0	Complies	Appendix M2
2462.0	-8.30	8.0	Complies	Appendix M2

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

6.3 Configuration 802.11g - Turbo Operating Mode

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

Frequency MHz	Level dBm	Limit dBm	Result	Spectral Density plots
2437.0	-9.78	8.0	Complies	Appendix M2

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 Module (Atheros), Model WLL4030 installed in Fujitsu Stylistic Pentablet PC, Model ST5010D (Ocampa), tested on behalf of Fujitsu Australia Ltd, **complies** 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:

FCC PART 15 Subpart C (Section 15.247: 2400 - 2483.5 MHz band)

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 with SAR requirements**
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	**Complies**
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	**Complies**

***Refer to EMC Technologies' report M030949_Ocampa_Atheros_2.4 SAR Report**

APPENDIX A
MEASUREMENT INSTRUMENTATION DETAILS

EQUIPMENT TYPE	MAKE/MODEL SERIAL NUMBER	LAST CAL. DD/MM/YY	DUE DATE DD/MM/YY	CAL. 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 9 kHz – 26 GHz	13/06/03	13/06/04	1 YEAR *2
EMI RECEIVER	Rohde & Schwarz, Model ESIB40 SN 1088 7490, 20 Hz – 40 GHz	09/07/03	09/07/04	1 YEAR *3
ANTENNAS	EMCO 93110B BICONICAL	20/08/03	20/08/04	1 YEAR *1
	20 - 300 MHz Sn. 9804-3092			
	EMCO 93146A LOG PERIODIC	11/07/03	11/07/04	1 YEAR *1
	200 -1000MHz Sn. 5033			
	EMCO 3115 DOUBLE RIDGED HORN 1 - 18 GHz Sn: 8908-3282	29/01/03	29/01/04	1 YEAR *1
	EMCO 3116 Double Ridged Guide Horn	--------	--------	*4
	18 – 40 GHz Sn 2276			
LISN	EMCO 3825/2 50ohm / 50 microH	10/02/03	10/02/04	1 YEAR *1
	0.009 – 30MHz Sn.9607-2567			
ENVIRONMENTAL CHAMBER	Heraeus votsch, Type: HT 4033 Order number: 60884376 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

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

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

TEST REPORT APPENDICES

(Submitted as attachments)

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