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

FCC ID: EJE-WB0002

Industry Canada ID: 337J-WB0002

Test Sample: Mini-PCI WLAN (Atheros 11a+b/g) & Bluetooth Module

WLAN Model: WLL4030

Bluetooth Model: UGXZ5-102A

Report Number M040124_Cert_Onion_Atheros_5.2_BT

Tested for: Fujitsu Australia Ltd.

Issue Date: 20th February 2004

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**NATA Accredited Laboratory
Number: 5292**

EMI TEST REPORT FOR CERTIFICATION
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EMC Technologies Report No. M040124_Cert_Onion_Atheros_5.2_BT

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**EMI TEST REPORT FOR CERTIFICATION to
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Report Number: M040124_Cert_Onion_Atheros_5.2_BT
Test Sample: Mini-PCI WLAN (Atheros 11a+b/g) & Bluetooth Module

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

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

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

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

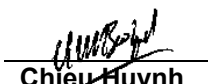
Tested for: Fujitsu Australia Ltd
Address: 5 Lakeside Drive,
Burwood East, VIC 3151 Australia
Phone: +613 9845 4300
Fax: +613 9845 4600
Contact: Mr Praveen Rao – Senior Compliance Engineer

Test Standards: FCC Part 15, Subpart E – Unlicensed National Information,
Infrastructure Devices
FCC Part 15.407, General Technical Requirements
ANSI C63.4 – 1992
OET Bulletin No. 63

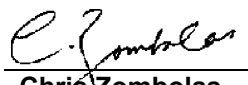
RSS-210 Issue 5 Low Power Licence-Exempt RadioCommunication
Devices:
6.2.2 (q1) 5150 - 5350 MHz & 5725-5825 MHz Local Area Network
Devices

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: 29th January to 10th February 2004

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

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

Authorised Signatory: 
Chris Zombolas
Technical Director
EMC Technologies Pty Ltd



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

1.0 INTRODUCTION

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

The Atheros module supports IEEE 802.11a, IEEE 802.11b and IEEE 802.11g configurations. Tests were performed in all three configurations. The results for configuration IEEE 802.11a are reported in this test report. The results for IEEE 802.11b, IEEE 802.11g configurations and the Bluetooth module are reported separately (Refer to EMC Technologies' test report: M040124_Cert_Onion_Atheros_2.4_BT).

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

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

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

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

1.1 Summary of Results

1.1.1 WLAN, Atheros 802.11a - FCC PART 15 Subpart E (Section 15.407)

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



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

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

Refer to EMC Technologies Report No: M040124_Cert_Onion_Atheros_2.4_BT

1.1.3 Bluetooth Module - FCC PART 15 Subpart C (Section 15.247)

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

Refer to EMC Technologies Report No: M040124_Cert_Onion_Atheros_2.4_BT

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

1.2 Modifications by EMC Technologies

No modifications were required.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample:	Mini-PCI WLAN (Atheros 11a+b/g) and Bluetooth module
WLAN Model Number:	WLL4030
WLAN Manufacturer:	Askey Computer Corp.
Interface Type:	Mini-PCI Wireless LAN Module
Bluetooth Model Number:	UGXZ5-102A
Bluetooth Manufacturer:	Fujitsu Japan Ltd
FCC ID:	EJE-WB0002
Industry Canada ID:	337J-WB0002
Equipment Type:	Intentional Radiator (Transceiver)



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

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

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

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

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

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

2.2 Technical Specifications

2.2.1 WLAN Transmitter Specifications

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

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

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

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

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



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

Turbo Mode: For 802.11g & 802.11a only
Data rate (Turbo): 12 MBps to 108 MBps

Frequency allocation for 802.11a:

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	--



2.2.2 Bluetooth Transmitter Specifications

Transmitter#2:	
Module:	ALPS Bluetooth Module
Model Number:	UGXZ5-102A
Manufacturer:	Fujitsu Japan Ltd
Network Standard:	Bluetooth™ RF Test Specification
Modulation Type:	Frequency Hopping Spread Spectrum (FHSS)
Frequency Range:	2402 MHz to 2480 MHz
Number of Channels:	79
Carrier Spacing:	1.0 MHz
Antenna Types:	Monopole Ceramic Chip Antenna
Max. Output Power:	12 dBm
Reference Oscillator:	16 MHz (Built-in)
Power Supply:	3.3 VDC from host.

Frequency allocation:

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

2.3 Operational Description

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

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

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

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

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

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

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

2.4 Test Configuration

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

Antenna

The Atheros (11a+b/g) WLAN (WLL4030) and ALPS Bluetooth device are configured with a Monopole Ceramic Chip antenna, Model YCE-5008. The installation of the OEM WLAN module, Bluetooth Device and the Antenna in Fujitsu LifeBook S Series, Model S701D (Onion) is in a controlled environment. The installation is performed during the production/assembly process at the Fujitsu factory.

Refer to Appendix N – Antenna Information.

AC Adapter

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

2.5 Block Diagram

Refer to Appendix D - Block Diagram

2.6 Support Equipment

External Monitor/s:

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

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

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

Headphones: Verbatim Multimedia Stereo headset

Modem: Maestro Companion Series 3

PS2 Mouse: Microsoft Intellimouse, S/N 00723014, FCC ID: C3KKS9

PS2 Keyboard Logitech, Model: YBA9, S/N MCT94602411

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

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

Secure Digital Slot: 32 MB Secure Digital storage device

2.7 Test Procedure

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

2.8 Test Facility

2.8.1 General

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

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

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

Industry Canada File Number, IC 4161, (Registration Date - November 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 (A²LA).

2.9 Units of Measurements



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

2.9.1 Conducted Emissions

Measurements are reported in units of dB relative to one microvolt. (dB μ V).

2.9.2 Radiated Emissions

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

2.10 Test Equipment Calibration

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

2.11 Ambients at OATS

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



RESULTS

WLAN Module - Atheros 802.11a (WLL4030)

1.0 CONDUCTED EMISSION MEASUREMENTS

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

1.1 Test Procedure

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

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

1.2 Peak Maximising Procedure

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

1.3 Calculation of Voltage Levels

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

$$VEMI = VRx + LBPF$$

Where:

- VEMI** = the Measured EMI voltage in dB μ V to be compared to the limit.
- VRx** = the Voltage in dB μ 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)

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

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in emissions were observed. Final testing was performed while the WLAN transmitter continuously operated with the modulation rate of 6 Mbps (BPSK) and the Bluetooth transmitter continuously operated.

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



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

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

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

Result: Complies

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

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

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

Result: Complies

2.0 RADIATED EMISSION MEASUREMENTS

2.1 Test Procedure

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

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

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

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

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (1000 MHz – 18,000 MHz) ± 4.1 dB
(30 MHz – 1,000 MHz) ± 3.7 dB



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

2.3.1 Frequency Band: 1 – 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 μ V/m limit at 3 metres has been converted to 64 dB μ 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 μ V/m @ 3m), except emissions within 10MHz of operating frequency range of 5.725 – 5825 GHz are –17 dBm (78.3 dB μ V/m @ 3m).

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

Testing was performed while both the WLAN transmitter and Bluetooth transmitter continuously operated. Harmonics related to the WLAN transmitter are reported below. For harmonics related to the Bluetooth transmitter, Refer to EMC Technologies' Report M040124_Cert_Onion_Atheros_2.4_BT.

The field strength at 5825 MHz when the EUT was operating at its highest channel (5805 MHz), was 49.6 dB μ 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 49.1 dB μ 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 54 Mbps (64QAM).

Channel 36 – 5180 MHz

Frequency MHz	Level dB μ V/m		Antenna Polarization	Peak Limit dB μ V/m	Average Limit dB μ V/m	Result
	Peak Detector	Average Detector				
5180	Transmitter	Fundamental				
10360	45.3	33.8	Vert/Hort	68.3	-	Pass
15540	52.5	41.6	Vert/Hort	74.0	54.0	Pass
20720	54.8	43.1	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
25900	58.1	46.2	Vert/Hort	78.3* (1m)	-	Pass
31080	67.6	54.5	Vert/Hort	78.3* (1m)	-	Pass
36260	68.9	55.9	Vert/Hort	78.3* (1m)	-	Pass

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

Channel 52 – 5260 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
5260	Transmitter	Fundamental				
10520	44.7	33.4	Vert/Hort	68.3	-	Pass
15780	51.2	40.8	Vert/Hort	74.0	54.0	Pass
21040	54.6	43.1	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26300	58.0	46.6	Vert/Hort	78.3* (1m)	-	Pass
31560	66.3	54.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
36820	68.8	56.3	Vert/Hort	78.3* (1m)	-	Pass

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

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	45.7	34.6	Vert/Hort	74.0	54.0	Pass
15960	50.8	40.7	Vert/Hort	74.0	54.0	Pass
21280	54.2	43.1	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26600	64.0	53.2	Vert/Hort	78.3* (1m)	-	Pass
31920	66.3	55.5	Vert/Hort	78.3* (1m)	-	Pass
37240	67.5	55.9	Vert/Hort	78.3* (1m)	-	Pass

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

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	45.9	34.5	Vert/Hort	74.0	54.0	Pass
17235	51.3	40.3	Vert/Hort	68.3	-	Pass
22980	54.7	43.1	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
28725	64.8	53.6	Vert/Hort	78.3* (1m)	-	Pass
34470	66.0	55.2	Vert/Hort	78.3* (1m)	-	Pass

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

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	46.4	34.8	Vert/Hort	74.0	54.0	Pass
17355	51.7	40.0	Vert/Hort	68.3	-	Pass
23140	54.6	43.2	Vert/Hort	78.3* (1m)	-	Pass
28925	64.5	53.7	Vert/Hort	78.3* (1m)	-	Pass
34710	66.6	54.7	Vert/Hort	78.3* (1m)	-	Pass

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

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	45.1	34.5	Vert/Hort	74.0	54.0	Pass
17415	51.3	40.2	Vert/Hort	68.3	-	Pass
23220	54.7	42.8	Vert/Hort	78.3* (1m)	-	Pass
29025	64.9	53.9	Vert/Hort	78.3* (1m)	-	Pass
34830	66.2	55.0	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 ± 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	45.0	34.3	Vert/Hort	68.3	-	Pass
15630	50.2	40.1	Vert/Hort	74.0	54.0	Pass
20840	53.8	43.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26050	57.5	45.9	Vert/Hort	78.3* (1m)	-	Pass
31260	66.6	53.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
36470	67.1	53.9	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass

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



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	44.4	33.6	Vert/Hort	68.3	-	Pass
15750	50.7	39.3	Vert/Hort	74.0	54.0	Pass
21000	53.9	43.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26250	57.5	45.7	Vert/Hort	78.3* (1m)	-	Pass
31500	66.5	53.7	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
36750	67.8	54.5	Vert/Hort	78.3* (1m)	-	Pass

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

Channel 56 – 5290 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
5290	Transmitter	Fundamental				
10580	44.9	34.1	Vert/Hort	68.3	-	Pass
15870	50.0	40.1	Vert/Hort	74.0	54.0	Pass
21160	53.7	42.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26450	57.4	45.6	Vert/Hort	78.3* (1m)	-	Pass
31740	66.1	53.7	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
37030	67.8	54.4	Vert/Hort	78.3* (1m)	-	Pass

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

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	45.8	34.3	Vert/Hort	74.0	54.0	Pass
17280	52.0	40.7	Vert/Hort	68.3	-	Pass
23040	54.9	43.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
28800	64.1	53.9	Vert/Hort	78.3* (1m)	-	Pass
34560	66.6	55.1	Vert/Hort	78.3* (1m)	-	Pass

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

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	45.5	34.5	Vert/Hort	74.0	54.0	Pass
17400	50.6	40.1	Vert/Hort	78.3* (1m)	-	Pass
23200	54.2	42.9	Vert/Hort	78.3* (1m)	-	Pass
29000	64.7	53.6	Vert/Hort	78.3* (1m)	-	Pass
34800	67.0	55.3	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 ± 4.1 dB.

Result: Complies



2.3.2 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres.

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

Initial investigations were performed with 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) and the Bluetooth transmitter continuously operated on the low (Channel 1, 2402 MHz) frequency channel.

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

Vertical Polarity

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

Horizontal Polarity

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

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

Result: Complies.



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 K 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 K 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 K 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 K 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 OUTPUT POWER - Section 15.407 (a)

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

Measurements were performed while the WLAN transmitter continuously transmitted.

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

The resolution bandwidth of 10 MHz and the video bandwidth of 10 MHz were utilised.

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

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

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). No significant differences in peak transmit power were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

Frequency MHz	A dBm	Cable Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
5180	15.2	- 0.8	1.79	16.2	17	41.7	50
5260	16.9	- 0.8	1.79	17.9	24	61.7	250
5320	17.5	- 0.8	1.79	18.5	24	70.8	250
5745	17.1	- 0.8	1.79	18.1	30	64.6	1000
5785	17.6	- 0.8	1.79	18.6	30	72.4	1000
5805	17.8	- 0.8	1.79	18.8	30	75.9	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).

Frequency MHz	A dBm	Cable Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
5210	14.5	- 0.8	1.79	15.5	17	35.5	50
5250	14.4	- 0.8	1.79	15.4	17	34.7	250
5290	14.6	- 0.8	1.79	15.6	24	36.3	250
5760	15.6	- 0.8	1.79	16.6	30	45.7	1000
5800	15.5	- 0.8	1.79	16.5	30	44.7	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.



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 54 Mbps (64QAM).

Channel	Frequency MHz	Bandwidth MHz	26 dB Bandwidth Plots
36	5180	26.05	Appendix J
52	5260	24.45	Appendix J
64	5320	24.05	Appendix J
149	5745	24.75	Appendix J
157	5785	26.05	Appendix J
161	5805	25.35	Appendix J

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	42.18	Appendix J
48	5250	42.59	Appendix J
56	5290	42.08	Appendix J
153	5760	42.69	Appendix J
161	5800	41.78	Appendix J

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 mobile device whereby a distance of 20 cm normally can be maintained between the user and the device.

In accordance with Section 1.1310, the Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure of 1.0 has been applied, i.e 1mW/cm².

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

where: P_d = power density (mW/cm²)

P = power input to the antenna (mW)

G = antenna gain (numeric)

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

The result was extracted from Part 1, section 3.0 of this report. (WLAN Module):

Maximum peak output power at the antenna terminal = 17.8dBm = 60.2mW

Antenna (Monopole Ceramic Chip) gain (typical) = 1.79 dBi = 1.51 numeric

Prediction distance = 20 cm

Prediction frequency = 5805 MHz

MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm²

Therefore, the power density at prediction frequency (P_d) = 0.0181 mW/cm²

The result was extracted from Part 2, section 3.0 of EMC Technologies Report No: M040124_Cert_Onion_Atheros_2.4_BT. (Bluetooth Module):

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

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

Prediction distance = 20 cm

Prediction frequency = 2402 MHz

MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm²

Therefore, the power density at prediction frequency (P_d) = 0.0046mW/cm²

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

$TP_d = 0.0181 \text{ (WLAN)} + 0.0046 \text{ (Bluetooth)} = 0.0227 \text{ mW/cm}^2$

Results: Complies



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). No significant differences in peak power spectral density were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

Channel	Frequency MHz	Peak Power Spectral Density (dBm)	Limit (dBm)	Result	Spectral Density plots
36	5180	0.71	4.0	Complies	Appendix L
52	5260	0.65	11.0	Complies	Appendix L
64	5320	0.69	11.0	Complies	Appendix L
149	5745	1.59	17.0	Complies	Appendix L
157	5785	1.77	17.0	Complies	Appendix L
161	5805	1.39	17.0	Complies	Appendix L

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).

Channel	Frequency MHz	Peak Power Spectral Density (dBm)	Limit (dBm)	Result	Spectral Density plots
36	5210	-1.34	4.0	Complies	Appendix L
48	5250	-0.94	4.0	Complies	Appendix L
56	5290	-1.15	11.0	Complies	Appendix L
153	5760	-0.48	17.0	Complies	Appendix L
161	5800	0.41	17.0	Complies	Appendix L

Result: Complies.

7.0 PEAK EXCURSION - Section 15.407 (a)

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

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

The peak transmit power was measured over an interval of continuous transmission using a calibrated spectrum analyser with the resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz for Trace 1 and video bandwidth of 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 54 Mbps (64QAM).

Channel	Frequency MHz	Peak Power Excursion (dB)	Limit (dB)	Result	Spectral Density plots
36	5180	3.55	13.0	Complies	Appendix M
52	5260	3.25	13.0	Complies	Appendix M
64	5320	3.39	13.0	Complies	Appendix M
149	5745	3.39	13.0	Complies	Appendix M
157	5785	3.34	13.0	Complies	Appendix M
161	5805	3.41	13.0	Complies	Appendix M

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	3.52	13.0	Complies	Appendix M
48	5250	2.94	13.0	Complies	Appendix M
56	5290	3.97	13.0	Complies	Appendix M
153	5760	2.90	13.0	Complies	Appendix M
161	5800	3.32	13.0	Complies	Appendix M

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 54 Mbps (64QAM).

Channel	Frequency MHz	Maximum Frequency Deviation kHz	Maximum Deviation %	± 0.02 % Limit kHz	Result
36	5180	248	0.0048	1036	Complies
52	5260	261	0.0050	1052	Complies
64	5320	277	0.0052	1064	Complies
149	5745	293	0.0051	1149	Complies
157	5785	309	0.0053	1157	Complies
161	5805	315	0.0054	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 %	± 0.02 % Limit kHz	Result
36	5210	272	0.0052	1042	Complies
48	5250	289	0.0055	1050	Complies
56	5290	307	0.0058	1058	Complies
153	5760	334	0.0058	1152	Complies
161	5800	356	0.0061	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.

10.0 COMPLIANCE STATEMENT

The Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4030 & ALPS Bluetooth Module, Model UGXZ5-102A, tested on behalf of Fujitsu Australia Ltd, **comply** with the requirements of 47 CFR, Part 15 Subpart E -Section 15.407 (5.15-5.35 GHz and 5.725-5.825 GHz bands).

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

Results were as follows:

WLAN, Atheros 802.11a - FCC PART 15 Subpart E (Section 15.407)

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

NB: Refer to EMC Technologies' Report M040124_Cert_Onion_Atheros_2.4_BT for Atheros 802.11b, 802.11g & Bluetooth module results.



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 8574B System Components	12/02/03	12/02/04	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 - 300 MHz Sn. 9804-3092	20/08/03	20/08/04	1 YEAR *1
	EMCO 93146A LOG PERIODIC 200 -1000MHz Sn. 5033	11/07/03	11/07/04	1 YEAR *1
	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 18 – 40 GHz Sn 2276	-----	-----	*4
LISN	EMCO 3825/2 50ohm / 50 microH 0.009 – 30MHz Sn.9607-2567	10/02/03	10/02/04	1 YEAR *1

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

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

Note *3. NATA calibration by Rohde & Schwarz

Note *4. Manufacturer's calibration

TEST SITES

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

APPENDIX A: MEASUREMENT INSTRUMENTATION DETAILS
APPENDIX B: REPORT PHOTOGRAPHS
APPENDIX C: FUNCTIONAL DESCRIPTION
APPENDIX D: BLOCK DIAGRAM
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APPENDIX I: GRAPHS of EMI MEASUREMENTS
APPENDIX J: CHANNEL BANDWIDTH PLOTS
APPENDIX K: BANDEDGE PLOTS
APPENDIX L: PEAK POWER SPECTRAL DENSITY PLOTS
APPENDIX M: PEAK EXCURSION PLOTS
APPENDIX N: ANTENNA INFORMATION (MONOPOLE CERAMIC CHIP ANTENNA)
APPENDIX O: USER MANUAL

Attachment 1: Atheros_11abg_FCC_Certificate

Attachment 2: Atheros_11abg_RSS_Certificate

Attachment 3: FCC DOC for LifeBook Onion S7010D

