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

FCC ID: EJE-WB0015
Industry Canada ID: 337J-WB0015

Test Sample: LifeBook E Series
Model: E8020D (Eton)

Radio Modules: Mini-PCI WLAN (Atheros 11a+b/g), Model: WLL4030 &
Bluetooth Model: UGXZ5-102A

Report Number M041106_Cert_Eton_Atheros_11abg_NII_BT

Tested for: Fujitsu Australia Ltd.

Issue Date: 30th November 2004

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NATA Accredited Laboratory
Number: 5292

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart E (Section 15.407) & RSS-210
EMC Technologies Report No. M041106_Cert_Eton_Atheros_11abg_NII_BT
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EMI TEST REPORT FOR CERTIFICATION
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FCC PART 15 Subpart E (Section 15.407) & RSS-210

Report Number: M041106_Cert_Eton_Atheros_11abg_NII_BT

Test Sample: LifeBook E Series
Model: E8020D (Eton)

Radio Modules: Mini-PCI WLAN, Model: WLL4030 (Askey Computer Corp.)
Bluetooth, Model: UGXZ5-102A (Fujitsu Ltd)

FCC ID: EJE-WB0015
Industry Canada ID: 337J-WB0015
Equipment Type: Intentional Radiator (Transceiver)

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

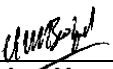
Tested for: Fujitsu Australia Ltd

Test Standards: FCC Part 15, Subpart E – Unlicensed National Information,
Infrastructure Devices
FCC Part 15.407, General Technical Requirements
ANSI C63.4 – 2003
OET Bulletin No. 65


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

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

Test Dates: 10th to 25th November 2004

Test Officers: 
Chieu Huynh B.Eng (Hons) Electronics
Adam Chowanetz
Jorge Lara

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

Authorised Signatory: 
Chris Zombolas
Technical Director
EMC Technologies Pty Ltd



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

1.0 INTRODUCTION

EMI testing was performed on test sample LifeBook E Series, Model: E8020D (Eton) with Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4030 & Bluetooth, Model UGXZ5-102A.

The Atheros WLAN supports IEEE 802.11a, IEEE 802.11b and IEEE 802.11g configurations. Tests were performed in all three configurations and also on the Bluetooth.

The results for configurations IEEE 802.11a are reported in this test report.

The results for IEEE 802.11b/g and Bluetooth are reported separately.
Refer to EMC Technologies' test report: M041106_Cert_Eton_Atheros_11abg_DTS_BT (802.11b/g) and M041106_Cert_Eton_BT_Atheros_11abg (Bluetooth).

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

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

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

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



1.1 Summary of Results

1.1.1 WLAN, 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 Band	Complies
15.207	6.6	Conducted Emissions	Complies
15.209	6.3	Radiated Emissions	Complies
15.407 (a)(4)	6.2.2(q1)	Peak Transmit Power	Complies
15.407 (a)(5)	6.2.2(q1)	Peak Power Spectral Density	Complies
15.407 (a)(6)		Peak Excursion	Complies
15.407 (b)	6.2.2(q1)	Undesirable Emission	Complies
15.407 (f)		Radio Frequency Hazard	Complies
15.407 (g)	6.4	Frequency Stability	Complies

1.1.2 WLAN, 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 Band	Complies
15.207	6.6	Conducted Emissions	Complies
15.209	6.3	Radiated Emissions	Complies
15.247 (a)(2)	6.2.2(o)(iv)	Channel Bandwidth	Complies
15.247 (b)(3)	6.2.2(o)(b)	Peak Output Power	Complies
15.247 (b)(5)		Radio Frequency Hazard	Complies
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	Complies
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	Complies

Refer to EMC Technologies Report No: M041106_Cert_Eton_Atheros_11abg_DTS_BT

1.1.3 Bluetooth - 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 Band	Complies
15.207	6.6	Conducted Emissions	Complies
15.209	6.3	Radiated Emissions	Complies
15.247 (a)(1)&(3)	6.2.2(o)(ii)	Channel Occupancy/Bandwidth	Complies
15.247 (b)(1)	6.2.2(o)(b)	Peak Output Power	Complies
15.247 (b)(5)		Radio Frequency Hazard	Complies
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	Complies

Refer to EMC Technologies Report No: M041106_Cert_Eton_BT_Atheros_11abg

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

1.2 Modifications by EMC Technologies

No modifications were required.



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2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample (Host PC):	LifeBook E Series
Model Number:	E8020D
Code Name:	Eton
Serial Number:	Pre-production Sample
Manufacturer:	Fujitsu Ltd
CPU Type and Speed:	Dothan 2.13 GHz Celeron-M 1.7 GHz
SDRAM:	1.0 GB
LCD Screen:	15"XGA / 15"SXGA / 15"UXGA
Hard Disk Drive:	40 GB
Wired LAN:	Broadcom BCM5751M 10 Base-T/100 Base-TX/1000 Base-T)
Modem:	MBH7MD33 / MBH7MD35
Wireless LAN Module:	Atheros 11a+b/g (WLL4030)
Bluetooth:	ALPS Bluetooth
Bluetooth Model Number:	UGXZ5-102A
Port Replicator Model:	FPCPR48
AC Adapter Model:	SEB100P2-19.0
Alternate Models:	CA01007-092x
Voltage:	19 V
Current Specs:	4.22 A
Watts:	80 W
Radio Modules:	WLAN (Atheros 11a+b/g) and Bluetooth
WLAN Model Number:	WLL4030
WLAN Manufacturer:	Askey Computer Corp.
Interface Type:	Mini-PCI Wireless LAN Module
Bluetooth Model Number:	UGXZ5-102A
Bluetooth Manufacturer:	Fujitsu Ltd
FCC ID:	EJE-WB0015
Industry Canada ID:	337J-WB0015
Equipment Type:	Intentional Radiator (Transceiver)



2.2 Technical Specifications

2.2.1 WLAN Transmitter Specifications

Transmitter:	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
802.11g	64QAM – 48Mbps, 54Mbps BPSK – 6Mbps, 9Mbps QPSK – 12Mbps, 18Mbps 16QAM – 24Mbps, 36Mbps
802.11b	64QAM – 48Mbps, 54Mbps 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 Types:	2 x Inverted-F Antenna – PN: CP115412-01 Located on top edge of LCD screen
Antenna gain:	802.11b/g = 1.06 dBi 802.11a (5.15 – 5.35 GHz) = -2.0 dBi 802.11a (5.725 – 5.825 GHz) = -1.18 dBi
Max. Output Power:	802.11b = 15 dBm 802.11g = 14.5 dBm 802.11a Band 1 (5.15 to 5.25 GHz) = 13.5 dBm 802.11a Band 2 (5.25 to 5.35 GHz) = 14 dBm 802.11a Band 3 (5.725 to 5.825 GHz) = 14.5 dBm
Power Supply:	3.3 VDC from PCI bus
Chipset Used:	Atheros AR5212, AR5112
Turbo Mode:	For 802.11g & 802.11a only
Data rate (Turbo):	12 Mbps to 108 Mbps

Frequency allocation for 802.11b/g:

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



Frequency allocation for 802.11a:

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

2.2.2 Bluetooth Transmitter Specifications

Transmitter:	Bluetooth
Model Number:	UGXZ5-102A
Manufacturer:	Fujitsu 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 Antenna, Model Number: YCE-5250 Located on the right hinge of LCD screen
Antenna gain:	0.6 dBi
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 LifeBook E Series, Model: E8020D (Eton) installed with a Mini-PCI Wireless LAN (WLAN) Module (Atheros 11a+b/g, Model WLL4030) & Bluetooth, Model UGXZ5-102A.

The WLAN module is an OEM product from Askey Computer Corp., which is already certified by the manufacturer FCC ID: H8NWLL4030 and IC: 1353A-WLL4030. The same WLAN radio module and Bluetooth combination has been previously certified by Fujitsu under FCC ID: EJE-WB0009 and IC: 337J-WB0009 in a different host.

The intention of this application is to re-certify this WLAN and Bluetooth with a different antenna combination in host – LifeBook E Series, Model: E8020D (Eton).

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.

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

Antenna

The Atheros (11a+b/g) WLAN, Model WLL4030, is configured with Inverted-F Antenna – PN: CP115412-01 and ALPS Bluetooth device, Model UGXZ5-102A is configured with Monopole Ceramic Antenna - model Number: YCE-5250. The installation of the OEM WLAN module, Bluetooth Device and the Antenna in Fujitsu LifeBook E Series, Model: E8020D (Eton) is in a controlled environment. The installation is performed during the production/assembly process at the Fujitsu factory.

Refer to Appendix F – Antenna Information.

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

Refer to photos in Appendix B3 for WLAN Antenna locations.

AC Adapter

The AC adapter SEB100P2-19.0 was used for all the tests. This adapter is also identified as CA01007-092x. Details of the AC adapters are supplied in section 2.1 of this report.

2.5 Block Diagram

Refer to Appendix D - Block Diagram



2.6 Support Equipment

External Monitor/s:

Conducted EMI

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

Radiated EMI

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

Printer:

HP Deskjet 930C, Serial: MY11H180DP

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

PS2 Mouse

A4 Tech M/N: SWW-25

Modem:

Maestro Companion Series 3

LAN Hub:

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

Headphones:

Verbatim Multimedia Stereo headset

PCMCIA Slot:

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

Memory Card:

Secure Digital- 32 MB

2.7 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-2003. Radiated emissions tests were performed at a distance of 3 and 10 metres from the EUT. OET Bulletin 65 dated June 2001 was used for reference.

2.8 Test Facility

2.8.1 General

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

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

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

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



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2.9 Units of Measurements

2.9.1 Conducted Emissions

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

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 - WLL4030 (802.11a of Atheros 11a+b/g)

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 C63.4-2003 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 C63.2-1996 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 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)

Measurements were performed on the LifeBook E Series (Eton), with WLAN module and Bluetooth.

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 WLAN & Bluetooth emissions.

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
0.377	Active	45.9	58.3	-12.5	41.8	48.3	-6.5
0.382	Neutral	45.3	58.2	-12.9	40.9	48.2	-7.3
0.478	Neutral	44.6	56.4	-11.8	38.5	46.4	-7.9
0.203	Active	54.3	63.5	-9.2	45.5	53.5	-8.0
0.204	Neutral	53.9	63.4	-9.6	45.4	53.4	-8.0
0.487	Active	44.5	56.2	-11.7	31.8	46.2	-14.4
0.290	Active	46.2	60.5	-14.3	33.7	50.5	-16.8
3.643	Neutral	36.5	56.0	-19.5	24.3	46.0	-21.7
3.668	Active	36.2	56.0	-19.8	23.7	46.0	-22.3

The worst case conducted EMI occurred at 0.377 MHz and complied with the quasi peak and average limits by margins of 12.5 dB and 6.5 dB respectively. The measurement uncertainty was ± 2.0 dB. Refer to Appendix I (graphs 1 & 2) 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 dB μ V/m.

V = EMI Receiver Voltage in dB μ V. (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 dB μ V is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9 dB while the preamplifier gain is 20 dB. The resulting Field Strength is therefore as follows:

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

Measurement uncertainty with a confidence interval of 95% is:

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



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

2.3.1 Frequency Band: 1 – 40 GHz

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

The 54 dB 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 M041106_Cert_Eton_BT_Atheros_11abg.

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).

The field strength at 5825 MHz (band 2) when the EUT was operating at its highest channel (5805 MHz), was 74.5 dB μ V/m peak & 59.2 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5725 MHz (band 2) when the EUT was operating at its lowest channel (5745 MHz), was 73.6 dB μ V/m peak & 57.6 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5350 MHz (band 1) when the EUT was operating at its highest channel (5320 MHz), was 60.4 dB μ V/m peak & 45.8 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5150 MHz (band 1) when the EUT was operating at its lowest channel (5180 MHz), was 62.0 dB μ V/m peak & 47.1 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

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	56.7	43.3	Vert/Hort	68.3	-	Pass
15540	62.1	48.6	Vert/Hort	74.0	54.0	Pass
20720	64.5	49.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
25900	68.3	54.2	Vert/Hort	78.3* (1m)	-	Pass
31080	77.7	64.0	Vert/Hort	78.3* (1m)	-	Pass
36260	83.2**	69.4	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results



Channel 52 – 5260 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
5260	Transmitter	Fundamental				
10520	56.7	43.3	Vert/Hort	68.3	-	Pass
15780	62.1	48.6	Vert/Hort	74.0	54.0	Pass
21040	64.5	49.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26300	68.3	54.2	Vert/Hort	78.3* (1m)	-	Pass
31560	77.7	64.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
36820	83.2**	69.4	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results

Channel 64 – 5320 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
5320	Transmitter	Fundamental				
10640	56.7	43.3	Vert/Hort	74.0	54.0	Pass
15960	62.1	48.6	Vert/Hort	74.0	54.0	Pass
21280	64.5	49.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26600	68.3	54.2	Vert/Hort	78.3* (1m)	-	Pass
31920	77.7	64.0	Vert/Hort	78.3* (1m)	-	Pass
37240	83.2**	69.4	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results

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	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17235	64.1	49.6	Vert/Hort	68.3	-	Pass
22980	65.5	50.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
28725	69.3	55.2	Vert/Hort	78.3* (1m)	-	Pass
34470	78.7**	65.0	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results



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	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17355	64.1	49.6	Vert/Hort	68.3	-	Pass
23140	65.5	50.5	Vert/Hort	78.3* (1m)	-	Pass
28925	69.3	55.2	Vert/Hort	78.3* (1m)	-	Pass
34710	78.7**	65.0	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results

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	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17415	64.1	49.6	Vert/Hort	68.3	-	Pass
23220	65.5	50.5	Vert/Hort	78.3* (1m)	-	Pass
29025	69.3	55.2	Vert/Hort	78.3* (1m)	-	Pass
34830	78.7**	65.0	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results

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



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).

The field strength at 5825 MHz (band 2) when the EUT was operating at its highest channel (5800 MHz), was 78.2 dB μ V/m peak & 64.3 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5725 MHz (band 2) when the EUT was operating at its lowest channel (5760 MHz), was 73.8 dB μ V/m peak & 59.1 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5350 MHz (band 1) when the EUT was operating at its highest channel (5290 MHz), was 58.2 dB μ V/m peak & 44.6 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5150 MHz (band 1) when the EUT was operating at its lowest channel (5210 MHz), was 59.1 dB μ V/m peak & 44.3 dB μ V/m average and was > 20 dB below the maximum field strength of the in-band carrier.

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	56.7	43.3	Vert/Hort	68.3	-	Pass
15630	62.1	48.6	Vert/Hort	74.0	54.0	Pass
20840	64.5	49.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26050	68.3	54.2	Vert/Hort	78.3* (1m)	-	Pass
31260	77.7	64.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
36470	83.2	69.4**	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass

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

**Refer to result.

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	56.7	43.3	Vert/Hort	68.3	-	Pass
15750	62.1	48.6	Vert/Hort	74.0	54.0	Pass
21000	64.5	49.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26250	68.3	54.2	Vert/Hort	78.3* (1m)	-	Pass
31500	77.7	64.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
36750	83.2**	69.4	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to result.



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	56.7	43.3	Vert/Hort	68.3	-	Pass
15870	62.1	48.6	Vert/Hort	74.0	54.0	Pass
21160	64.5	49.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
26450	68.3	54.2	Vert/Hort	78.3* (1m)	-	Pass
31740	77.7	64.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
37030	83.2**	69.4	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results

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	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17280	64.1	49.6	Vert/Hort	68.3	-	Pass
23040	65.5	50.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
28800	69.3	55.2	Vert/Hort	78.3* (1m)	-	Pass
34560	78.7**	65.0	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results

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	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17400	64.1	49.6	Vert/Hort	78.3* (1m)	-	Pass
23200	65.5	50.5	Vert/Hort	78.3* (1m)	-	Pass
29000	69.3	55.2	Vert/Hort	78.3* (1m)	-	Pass
34800	78.7**	65.0	Vert/Hort	78.3* (1m)	-	Pass

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

**Refer to results

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

2.3.1.3 Spurious Emissions Generated When Both (WLAN and BT) Transmitters Transmitting

Result: No spurious were recorded within the restricted bands of up to 40 GHz. 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.



2.3.2 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres.

Measurements were performed on the LifeBook E Series (Eton), with WLAN module and Bluetooth.

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
233.41	Vertical	35.0	35.5	-0.5
249.75	Vertical	32.1	35.5	-3.4
214.26	Vertical	27.1	33.0	-5.9
207.77	Vertical	26.9	33.0	-6.1
371.63	Vertical	28.8	35.5	-6.8
122.90	Vertical	23.8	33.0	-9.2
325.44	Vertical	25.6	35.5	-9.9
142.87	Vertical	22.3	33.0	-10.7
124.47	Vertical	22.0	33.0	-11.0
678.76	Vertical	23.1	35.5	-12.5
200.02	Vertical	20.5	33.0	-12.5
184.35	Vertical	19.4	33.0	-13.6
120.80	Vertical	19.2	33.0	-13.8

Horizontal Polarity

Frequency MHz	Polarisation	QP Measured dB μ V/m	QP Limit dB μ V/m	Δ QP \pm dB
207.77	Horizontal	29.4	33.0	-3.6
214.26	Horizontal	26.3	33.0	-6.8
272.69	Horizontal	26.7	35.5	-8.8
240.23	Horizontal	24.9	35.5	-10.6
279.18	Horizontal	24.7	35.5	-10.8
232.26	Horizontal	24.1	35.5	-11.4
408.00	Horizontal	23.7	35.5	-11.8
122.90	Horizontal	19.4	33.0	-13.6
120.77	Horizontal	18.2	33.0	-14.8
795.02	Horizontal	20.5	35.5	-15.0
119.25	Horizontal	18.0	33.0	-15.0
597.26	Horizontal	18.2	35.5	-17.3

Result: The highest radiated emission peak occurred at 233.41 MHz (Vertical Polarity) and complied with FCC quasi peak limit by a margin of 0.5 dB. The measurement uncertainty in this band was ± 3.7 dB. Refer to tables above for results.



2.3.3 RF Conducted Measurements at the antenna terminal

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

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

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

Refer to Appendix K for Harmonics plots

Result: Complies.

2.3.4 Band Edge Measurements

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

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

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

2.3.4.1 Configuration 802.11a - Normal Operating Mode**Band1: 5.150 – 5.350 GHz**

Refer to Appendix L for Band Edge plots

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

Band2: 5.725 – 5.825 GHz

Refer to Appendix L for Band Edge plots

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

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

2.3.4.2 Configuration 802.11a - Turbo Operating Mode**Band1: 5.150 – 5.350 GHz**

Refer to Appendix L for Band Edge plots

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

Band2: 5.725 – 5.825 GHz

Refer to Appendix L for Band Edge plots

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

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

Result: Complies.



3.0 PEAK 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.

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

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 802.11a – 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).

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

Frequency MHz	P dBm	Limit dBm	P mW	Limit mW	Power Plots
5180	16.8	17	47.9	50	Appendix M
5260	17.5	24	56.2	250	Appendix M
5320	18.3	24	67.6	250	Appendix M
5745	16.3	30	42.7	1000	Appendix M
5785	15.4	30	34.7	1000	Appendix M
5805	15.0	30	31.6	1000	Appendix M

Result: Complies.

3.2 Configuration 802.11a – Turbo Operating Mode

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

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

Frequency MHz	P dBm	Limit dBm	P mW	Limit mW	Power Plots
5210	17	17	50.0	50	Appendix M
5250	18.1	24	64.6	250	Appendix M
5290	18.8	24	75.9	250	Appendix M
5760	16.3	30	42.7	1000	Appendix M
5800	15.5	30	36.3	1000	Appendix M

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 (5.15 - 5.35 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	22.8	Appendix J
52	5260	24.1	Appendix J
64	5320	23.0	Appendix J
149	5745	26.3	Appendix J
157	5785	27.4	Appendix J
161	5805	27.9	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	43.1	Appendix J
48	5250	42.7	Appendix J
56	5290	44.5	Appendix J
153	5760	47.7	Appendix J
161	5800	49.5	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).

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

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

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

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

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

In accordance with Section 1.1310, the Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure of 1.0 has been applied, i.e 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 section 3.0 of this report (WLAN Module):

Maximum peak output power = 18.8dBm = 76mW

Antenna (Inverted F) gain (typical) = -2.0 dBi = 0.63 numeric

Prediction distance = 20 cm

Prediction frequency = 5290 MHz

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

The power density calculated = 0.010 mW/cm²

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



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 2 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 (5.15 - 5.35 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	4.0	4.0	Complies	Appendix N
52	5260	2.1	11.0	Complies	Appendix N
64	5320	-0.6	11.0	Complies	Appendix N
149	5745	6.1	17.0	Complies	Appendix N
157	5785	7.8	17.0	Complies	Appendix N
161	5805	8.4	17.0	Complies	Appendix N

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	2.8	4.0	Complies	Appendix N
48	5250	1.5	4.0	Complies	Appendix N
56	5290	-3.0	11.0	Complies	Appendix N
153	5760	4.3	17.0	Complies	Appendix N
161	5800	6.0	17.0	Complies	Appendix N

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 (5.15 - 5.35 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	5.3	13.0	Complies	Appendix O
52	5260	4.2	13.0	Complies	Appendix O
64	5320	3.2	13.0	Complies	Appendix O
149	5745	3.5	13.0	Complies	Appendix O
157	5785	2.8	13.0	Complies	Appendix O
161	5805	3.3	13.0	Complies	Appendix O

Result: Complies.

7.2 Configuration 802.11a – Turbo Operating Mode

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

Channel	Frequency MHz	Peak Power Excursion (dB)	Limit (dB)	Result	Spectral Density plots
36	5210	4.4	13.0	Complies	Appendix O
48	5250	2.9	13.0	Complies	Appendix O
56	5290	3.8	13.0	Complies	Appendix O
153	5760	3.0	13.0	Complies	Appendix O
161	5800	3.7	13.0	Complies	Appendix O

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 (5.15 - 5.35 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 %	$\pm 0.02\%$ Limit kHz	Result
36	5180	230	0.004	1036	Complies
52	5260	232	0.004	1052	Complies
64	5320	297	0.006	1064	Complies
149	5745	283	0.005	1149	Complies
157	5785	304	0.005	1157	Complies
161	5805	341	0.006	1161	Complies

Result: Complies.

8.2 Configuration 802.11a – Turbo Operating Mode

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

Channel	Frequency MHz	Maximum Frequency Deviation kHz	Maximum Deviation %	$\pm 0.02\%$ Limit kHz	Result
36	5210	323	0.006	1042	Complies
48	5250	361	0.007	1050	Complies
56	5290	355	0.007	1058	Complies
153	5760	363	0.006	1152	Complies
161	5800	402	0.007	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 LifeBook E Series, Model: E8020D (Eton) with Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4030 & Bluetooth, Model UGXZ5-102A, tested on behalf of Fujitsu Australia Ltd, **comply** with the requirements of 47 CFR, Part 15 Subpart E -Section 15.407 (5.15-5.35 GHz and 5.725-5.825 GHz bands).

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

Results were as follows:

WLAN, 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 Band	Complies
15.207	6.6	Conducted Emissions	Complies
15.209	6.3	Radiated Emissions	Complies
15.407 (a)(4)	6.2.2(q1)	Peak Transmit Power	Complies
15.407 (a)(5)	6.2.2(q1)	Peak Power Spectral Density	Complies
15.407 (a)(6)		Peak Excursion	Complies
15.407 (b)	6.2.2(q1)	Undesirable Emission	Complies
15.407 (f)		Radio Frequency Hazard	Complies
15.407 (g)	6.4	Frequency Stability	Complies

The results for Atheros 802.11b/g and Bluetooth are reported separately.

Refer to EMC Technologies' test report: M041106_Cert_Eton_Atheros_11abg_DTS_BT (802.11b/g) and M041106_Cert_Eton_BT_Atheros_11abg (Bluetooth).



TEST REPORT APPENDICES

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Attachment 1: RF Exposure Information

Attachment 2: FCC DOC for LifeBook E Series (Eton)



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