EMC Technologies Pty Ltd
ABN 82 057 105 549
57 Assembly Drive
Tullamarine Victoria Australia 3043

Ph: + 613 9335 3333
Fax: + 613 9338 9260
email: melb@emctech.com.au

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

FCC ID: **EJE-WB0029**
Industry Canada ID: **337J-WB0029**

Test Sample: LifeBook T Series
Model: T4020D

Radio Modules: Mini-PCI WLAN (Atheros 11a+b/g), Model: WLL4070 & Bluetooth Model: UGXZ5-102A

Report Number M050510_Cert_WLL4070_11abg_NII_BT

Tested for: Fujitsu Australia Ltd.

Issue Date: 25th May 2005

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. M050510_Cert_WLL4070_11abg_NII_BT

Issue Date: 25th May 2005

CONTENTS

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

Report Number:	M050510_Cert_WLL4070_11abg_NII_BT
Test Sample:	LifeBook T Series
Model:	T4020D
Radio Modules:	Mini-PCI WLAN, Model: WLL4070 (Askey Computer Corp.) Bluetooth, Model: UGXZ5-102A (Fujitsu Ltd)
FCC ID:	EJE-WB0029
Industry Canada ID:	337J-WB0029
Equipment Type:	Intentional Radiator (Transceiver)
Manufacturer (LifeBook):	Fujitsu Ltd
Address:	1405, Ohamaru, Inagi-shi, Tokyo 206-8503, Japan
Contact:	Mr. Tsuyoshi Uchihara
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:	11th – 22nd May 2005
Test Officers:	**Chieu Huynh - B.Eng (Hons) Electronics** **Kevin Hansen**
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 T Series, Model: T4020D with Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4070 & Bluetooth, Model UGXZ5-102A.

The Atheros WLAN supports IEEE 802.11a (DTS and UNII), 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 (UNII: 5150 – 5350 MHz) are reported in this test report.

The results for IEEE 802.11b/g and IEEE 802.11a (DTS: 5725 – 5850 MHz) and Bluetooth are reported separately.
Refer to EMC Technologies' test report: M050510_Cert_WLL4070_11abg_DTS_BT (802.11b/g and 802.11a (DTS: 5725 – 5850 MHz)) and M050510_Cert_BT_WLL4070_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 5.725-5825 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 with SAR requirements**
15.407 (g)	6.4	Frequency Stability	**Complies**

1.1.2 WLAN, Atheros 802.11b/g and 802.11a (DTS) - 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 with SAR requirements**
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	**Complies**
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	**Complies**

Refer to EMC Technologies Report No: M050422_Cert_WLL4070_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 with SAR requirements**
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	**Complies**

Refer to EMC Technologies Report No: M050422_Cert_BT_WLL4070_11abg

*Refer to EMC Technologies' report M050511_Cert_WLL4070_SAR_2.4 and M050511_Cert_WLL4070_SAR_5.2

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.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample (Host PC):	LifeBook T Series
Model Number:	T4020D
Serial Number:	Pre-production Sample
Manufacturer:	Fujitsu Ltd
CPU Type and Speed:	Pentium M 2.26 GHz
Wired LAN:	Broadcom BCM5751M : 10 Base-T/100 Base-TX/1000 Base-T
Modem:	Agere MDC 1.5, Model: AM2
Port Replicator Model:	FPCPR49
AC Adapter Model:	SEC80N2-19.0 / UJ99 (60W) SEB100P2-19.0 / SQ2N80W19P-xx (80W)
Voltage:	19 V
Current Specs:	3.16 A / 4.22 A
Watts:	60 W / 80 W
Radio Modules:	WLAN (Atheros 11a+b/g) and Bluetooth
WLAN Model Number:	WLL4070
WLAN Manufacturer:	Askey Computer Corp.
Interface Type:	Mini-PCI Wireless LAN Module
Bluetooth Model Number:	UGXZ5-102A (ALPS)
Bluetooth Manufacturer:	Fujitsu Ltd.
FCC ID:	EJE-WB0029
Industry Canada ID:	337J-WB0029
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:	WLL4070 (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 - 5.850 GHz for 11a
Antenna Types:	NEC Tokin (Monopole Antenna) – Model: DA120D-2454M-FJ01 Located on top edge (right and left) of LCD screen
Antenna gain:	802.11b/g = 2.04 dBi 802.11a (5.15 – 5.35 GHz) = 1.29 dBi 802.11a (5.725 – 5.825 GHz) = 0.88 dBi
Power Supply:	3.3 VDC from PCI bus
Chipset Used:	Atheros AR5414, AR5413
Turbo Mode:	For 802.11g & 802.11a only
Data rate (Turbo):	12 Mbps to 108 Mbps

Frequency allocation and maximum output power setting for 802.11b/g:

Channel Number	Frequency (MHz)	EUT Power level setting dBm	
		802.11b	802.11g
1	**2412***	**18**	**17**
2	2417	18	17
3	2422	18	17
4	2427	18	17
5	2432	18	17
6	**2437***	**18**	**17**
6 Turbo (802.11g only)	**2437***	**-**	**15**
7	2442	18	17
8	2447	18	17
9	2452	18	17
10	2457	18	17
11	**2462**	**18**	**17**

*Channels tested and reported in the DTS submission (M050510_Cert_WLL4070_11abg_DTS_BT)

Frequency allocation and maximum output power setting for 802.11a:

Channel Number	Frequency (MHz)	Power level setting dBm
*Channels tested and reported in the DTS submission (M050510_Cert_WLL4070_11abg_DTS_BT)		
149	**5745***	**16**
152	***5760 Turbo**	**17**
153	5765	16
157	**5785***	**16**
160	***5800 Turbo**	**17**
161	5805	16
165	**5825***	**16**
*Channels tested and reported in this report		
36	**5180***	**14**
40	5200	14
42	***5210 Turbo**	**13**
44	5220	14
48	5240	14
50	***5250 Turbo**	**13**
52	**5260***	**17**
56	5280	17
58	***5290 Turbo**	**17**
60	5300	17
64	**5320***	**17**

0

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:	NEC Tokin (Monopole Antenna) – Model: DA120D-2454M-FJ01 Located on top center of LCD screen
Antenna gain:	0.05 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)	Bluetooth Utility power setting
1*	**2402**	Power (Ext, Int) = 180, 50
2	2403	
3	2404	
.	.	
.	.	
.	.	
39	2440	
40*	**2441**	
41	2442	
.	.	
.	.	
.	.	
77	2478	
78	2479	
79*	**2480**	

*Channels tested and reported in the Bluetooth submission (M050510_Cert_BT_WLL4070_11abg)

2.3 Operational Description

The EUT is a LifeBook T Series, Model: T4020D installed with a Mini-PCI Wireless LAN (WLAN) Module (Atheros 11a+b/g, Model WLL4070) & Bluetooth, Model UGXZ5-102A.

The same WLAN radio module and Bluetooth combination has been previously certified by Fujitsu under FCC ID: EJE-WB0023 and IC: 337J-WB0023 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 T Series, Model: T4020D.

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 WLL4070, and ALPS Bluetooth device are configured with NEC Tokin (Monopole) Antenna – Model: DA120D-2454M-FJ01. The installation of the OEM WLAN module, Bluetooth Device and the Antenna in Fujitsu LifeBook T Series, Model: T4020D 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 (x2) are located on the top edge (left and right) of LCD screen. Bluetooth antenna is located on top center of LCD screen.

Refer to photos in Appendix B3 for WLAN Antenna locations.

AC Adapter

The AC adapter SEC80N2-19.0 was used for all the tests. Details of the AC adapter are supplied in section 2.1 of this report.

2.5 Block Diagram

Refer to Appendix D - Block Diagram

2.6 Support Equipment

Refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-051EAL)

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 test sites have been accepted for testing by the Federal Communications Commission (FCC) - **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.

2.8.2 NATA Accreditation

EMC Technologies is accredited in Australia to test to the following standards by the National Association of Testing Authorities (NATA).

"FCC Part 15 unintentional and intentional emitters in the frequency range 9kHz to 18 GHz excluding TV receivers (15.117 and 15.119), TV interface devices (15.115), cable ready consumer electronic equipment (15.118), cable locating equipment (15.213) and unlicensed national information infrastructure devices (Sub part E)."

The current full scope of accreditation can be found on the NATA website: www.nata.asn.au
It also includes a large number of emission, immunity, SAR, EMR and Safety standards.

NATA is the Australian national laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Laboratory (NML) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A^2LA).

2.9 Units of Measurements

2.9.1 Conducted Emissions

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

2.9.2 Radiated Emissions

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

2.10 Test Equipment Calibration

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

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 - WLL4070 (802.11a of Atheros 11a+b/g)

3.0 CONDUCTED EMISSION MEASUREMENTS

Testing was performed in accordance with the requirements of FCC Part 15.207
Refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-051EAL)

4.0 RADIATED EMISSION MEASUREMENTS

4.1 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. 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, refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-051EAL).

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.

4.2 Calculation of field strength

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

E = V + AF - G + L Where:

E = Radiated Field Strength in dBµV/m.
V = EMI Receiver Voltage in dBµV. (measured value)
AF = Antenna Factor in dB(m^{-1}). (stored as a data array)
G = Preamplifier Gain in dB. (stored as a data array)
L = Cable insertion loss in dB. (stored as a data array of Insertion Loss versus frequency)

- **Example Field Strength Calculation**

Assuming a receiver reading of 34.0 dBµV is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9 dB while the preamplifier gain is 20 dB. The resulting Field Strength is therefore as follows:

34.0 + 9.2 + 1.9 - 20 = 25.1 dBµV/m

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (1000 MHz – 18,000 MHz) ± 4.1 dB

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

4.3.1 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 dBμV/m limit at 3 metres has been converted to 64 dBμV/m at 1 metre using a factor of 20 dB per decade where emissions were located in the restricted bands.

The peak limits for undesirable emission outside of the restricted bands are –27 dBm (68.3 dBuV/m @ 3m).

Measurements were performed on frequency band (5.15 - 5.35 GHz)

Testing was performed while both the WLAN transmitter and Bluetooth transmitter continuously operated. Harmonics related to the WLAN transmitter (5.15 – 5.35 GHz) are reported below. Harmonics in the frequency bands (2.4 – 2.4835 GHz and 5725 – 5850 GHz), refer to M050510_Cert_WLL4070_11abg_DTS_BT. For harmonics related to the Bluetooth transmitter, refer to M050510_Cert_BT_WLL4070_11abg.

4.3.1.1 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 5350 MHz when the EUT was operating at its highest channel (5320 MHz), was 58.8 dBμV/m peak & 47.5 dBμV/m average 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 58.0 dBμV/m peak & 45.3 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

Channel 36 – 5180 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/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

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.

4.3.1.2 Configuration 802.11a – Turbo Operating Mode

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

The field strength at 5350 MHz, when the EUT was operating at its highest channel (5290 MHz), was 63.6 dBμV/m peak & 47.2 dBμV/m average 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 (5210 MHz), was 57.4 dBμV/m peak & 43.9 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

Channel 42 – 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 50 – 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 58 – 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

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.

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

Result: No spurious emissions were recorded within the restricted bands of up to 40 GHz. Spurious emissions were confirmed low with both RBW and VBW reduced. Emissions were complied with the FCC limits in sections 15.209 and 15.407. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.2 Frequency Band: 30 - 1000 MHz

Refer to Attachment 3 – FCC Part 15B Test Report (Report: FG05-051EAL).

4.3.3 RF Conducted Measurements at the antenna terminal

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.

Refer to Appendix K for Harmonics plots

Result: Complies.

4.3.4 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.

4.3.4.1 Configuration 802.11a - Normal Operating Mode

Refer to Appendix L for Band Edge plots

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

4.3.4.2 Configuration 802.11a - Turbo Operating Mode

Refer to Appendix L for Band Edge plots

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

5.0 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 peak output power measurement was performed using the integration method as per test method #3 of DA 02-2138. The resolution bandwidth of 1 MHz was used. The video bandwidth of 100 kHz was used (VBW ≥1/T, where T (worst case) = 360μS for normal operating mode and 180μS for turbo mode).

Measurements were performed on frequency band (5.15 - 5.35 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.

5.1 Configuration 802.11a – Normal Operating Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Peak output power with 64QAM modulation (rate = 54 Mbps) was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

Frequency MHz	P dBm	Limit dBm	P mW	Limit mW	Power Plots
5180	16.1	17	40.7	50	Pass
5260	19.2	24	83.2	250	Pass
5320	19.0	24	79.4	250	Pass

Result: Complies.

5.2 Configuration 802.11a – Turbo Operating Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Peak output power with 64QAM modulation (rate = 108 Mbps) was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 108 Mbps (64QAM).

Frequency MHz	P dBm	Limit dBm	P mW	Limit mW	Power Plots
5210	15.2	17	33.1	50	Pass
5250	15.3	17	33.9	50	Pass
5290	19.3	24	85.1	250	Pass

Result: Complies.

6.0 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 frequency band (5.15 - 5.35 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 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	23.9	Appendix J
52	5260	23.5	Appendix J
64	5320	23.0	Appendix J

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	Bandwidth MHz	26 dB Bandwidth Plots
42	5210	40.6	Appendix J
50	5250	41.2	Appendix J
58	5290	41.7	Appendix J

7.0 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 2400 - 2483.5 MHz and 5.150 – 5.350 GHz 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).

Transmitter # 1 (WLAN): The antennas are located on the top edge of LCD screen (2 antennas left and right) projected distance of less than 20cm from user.

Transmitter # 2 (Bluetooth): The antenna is located on the top center of LCD screen projected distance of less than 20cm from user.

The separation distance between the WLAN and BT antennas is less than 20cm. Therefore, they are co-located transmitters. Testing was performed with both WLAN and BT transmitters transmitting continuously.

In accordance with this section and also section 2.1093 this device has been defined as a portable device.

SAR testing was performed in accordance with OET Bulletin 65 and reported under EMC Technologies M050511_Cert_WLL4070_SAR_2.4 and M050511_Cert_WLL4070_SAR_5.2. The highest SAR value was 1.48 mW/g which complies with the FCC human exposure requirements of 47 CFR 2.1093 (d).

Refer to EMC Technologies' report - M050511_Cert_WLL4070_SAR_2.4 and M050511_Cert_WLL4070_SAR_5.2 for details of SAR compliance.

Results: Complies

8.0 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 power spectral density measurement was performed as per test method #2 of DA 02-2138. The resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz were utilised.

Measurements were performed on frequency band (5.15 - 5.35 GHz)

8.1 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	-2.7	4.0	Complies	Appendix M
52	5260	1.7	11.0	Complies	Appendix M
64	5320	1.7	11.0	Complies	Appendix M

Result: Complies.

8.2 Configuration 802.11a – Turbo 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 108 Mbps.

Channel	Frequency MHz	Peak Power Spectral Density (dBm)	Limit (dBm)	Result	Spectral Density plots
42	5210	-5.4	4.0	Complies	Appendix M
50	5250	-5.7	4.0	Complies	Appendix M
58	5290	-1.5	11.0	Complies	Appendix M

Result: Complies.

9.0 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 excursion 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 100 kHz for Trace 2. The difference between Trace 1 and Trace 2 was recorded.

Measurements were performed on frequency band (5.15 - 5.35 GHz)

9.1 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	7.4	13.0	Complies	Appendix N
52	5260	7.2	13.0	Complies	Appendix N
64	5320	6.1	13.0	Complies	Appendix N

Result: Complies.

9.2 Configuration 802.11a – Turbo 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 108 Mbps.

Channel	Frequency MHz	Peak Power Excursion (dB)	Limit (dB)	Result	Spectral Density plots
42	5210	6.4	13.0	Complies	Appendix N
50	5250	7.3	13.0	Complies	Appendix N
58	5290	6.9	13.0	Complies	Appendix N

Result: Complies.

10.0 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 ±15%. This was observed to have no effect on the results obtained.

Measurements were performed on frequency band (5.15 - 5.35 GHz)

10.1 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	151	0.003	1036	Complies
52	5260	158	0.003	1052	Complies
64	5320	179	0.004	1064	Complies

Result: Complies.

10.2 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
42	5210	167	0.004	1042	Complies
50	5250	153	0.003	1050	Complies
58	5290	184	0.004	1058	Complies

Result: Complies.

11.0 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.

12.0 COMPLIANCE STATEMENT

The LifeBook T Series, Model: T4020D with Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4070 & 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 band).

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 (U-NII) - 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 with SAR requirements**
15.407 (g)	6.4	Frequency Stability	**Complies**

*Refer to EMC Technologies' report M050511_Cert_WLL4070_SAR_2.4 and M050511_Cert_WLL4070_SAR_5.2

The results for Atheros 802.11b/g, 802.11a (DTS) and Bluetooth are reported separately.
Refer to EMC Technologies' test reports: M050510_Cert_WLL4070_11abg_DTS_BT (802.11b/g and 802.11a (DTS: 5725 – 5850 MHz)) and M050510_Cert_BT_WLL4070_11abg (Bluetooth).

TEST REPORT APPENDICES

APPENDIX A: MEASUREMENT INSTRUMENT DETAILS
APPENDIX B: REPORT PHOTOGRAPHS
APPENDIX C: FUNCTIONAL DESCRIPTION
APPENDIX D: BLOCK DIAGRAM
APPENDIX E: SCHEMATICS
APPENDIX F: ANTENNA DETAILS
APPENDIX G: SPECIFICATIONS
APPENDIX H: FCC LABELLING DETAILS
APPENDIX I: USER MANUAL
APPENDIX J: CHANNEL BANDWIDTH PLOTS
APPENDIX K: HARMONICS PLOTS
APPENDIX L: BANDEDGE PLOTS
APPENDIX M: PEAK POWER SPECTRAL DENSITY PLOTS
APPENDIX N: PEAK EXCURSION PLOTS

Attachment 1: RF Exposure Information
Attachment 2: FCC DOC for LifeBook T Series
Attachment 3: FCC Part 15B Test Report (Report: FG05-051EAL)