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

FCC ID:	EJE-WB0018
Industry Canada ID:	337J-WB0018
Test Sample:	LifeBook E Series
Model:	E8020D
Radio Modules:	Bluetooth, Model: UGXZ5-102A & Mini-PCI WLAN (Atheros 11a+b/g), Model: WLL4070
Report Number	M050215_Cert_BT_WLL4070_11abg
Tested for:	Fujitsu Australia Ltd.
Issue Date:	4th March 2005

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Radio Modules:	Bluetooth, Model: UGXZ5-102A (Fujitsu Ltd) Mini-PCI WLAN, Model: WLL4070 (Askey Computer Corp.)
FCC ID:	EJE-WB0018
Industry Canada ID:	337J-WB0018
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 C – Intentional Radiators FCC Part 15.247, 2400 – 2483.5 MHz Operation Band ANSI C63.4 – 2003 OET Bulletin No. 65 RSS-210 Issue 5 Low Power Licence-Exempt RadioCommunication Devices: 6.2.2 (o) 2400 – 2483.5 MHz Spread Spectrum RSS-102 Issue 1 (Provisional), Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields
Test Dates:	15th February – 2nd March 2005

Test Officers:

Chieu Huynh	**B.Eng (Hons) Electronics**
Janath Gunakesera	**BScEng., MTelcomEng, MIEEE**
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
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1.0 INTRODUCTION

EMI testing was performed on test sample LifeBook E Series, Model: E8020D with Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4070 & Bluetooth, Model UGXZ5-102A.

The WLAN supports IEEE 802.11b, IEEE 802.11g and IEEE 802.11a (DTS & U-NII) configurations. Tests were performed in all three configurations and also on the Bluetooth.

The results for the Bluetooth are reported in this test report.

The results for the WLAN Atheros module are reported separately.
Refer to EMC Technologies' test reports: M050215_Cert_WLL4070_11abg_DTS_BT (DTS) and M050215_Cert_WLL4070_11abg_NII_BT (U-NII).

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

47 CFR, Part 15, Subpart C:	Rules for intentional radiators (particularly section 15.247)
Section 15.203:	Antenna requirements
Section 15.205:	Restricted bands of operation
Section 15.207:	Conducted Emission Limits
Section 15.209:	Radiated Emission Limits (General requirements)
Section 15.247:	Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.247.

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

1.1 Summary of Results

1.1.1 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**

1.1.2 WLAN, Atheros: 802.11b, 802.11g and 802.11a (DTS) - FCC 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: M050215_Cert_WLL4070_11abg_DTS_BT

1.1.3 WLAN, Atheros: 802.11a (U-NII) - FCC 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**

Refer to EMC Technologies Report No: M050215_Cert_WLL4070_11abg_NII_BT

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 E Series
Model Number:	E8020D
Serial Number:	Pre-production Sample
Manufacturer:	Fujitsu Ltd
CPU Type and Speed:	Dothan 2.13 GHz Celeron-M 1.7 GHz
SDRAM:	512 MB
LCD Screen:	15”XGA / 15”SXGA / 15”UXGA
Hard Disk Drive:	60 GB
Wired LAN:	Broadcom BCM5751M 10 Base-T/100 Base-TX/1000 Base-T)
Modem:	MDC 1.5, Model: AM2
Wireless LAN Module:	Atheros 11a+b/g (WLL4070)
Bluetooth:	ALPS Bluetooth
Bluetooth Model Number:	UGXZ5-102A
Port Replicator Model:	FPCPR48
AC Adapter Model:	SEB100P2-19.0
Alternate Models:	SQ2N80W19P-01
Voltage:	19 V
Current Specs:	4.22 A (SEB100P2-19.0 / SQ2N80W19P-01),
Watts:	80 W (SEB100P2-19.0 / SQ2N80W19P-01),
Radio Modules:	Bluetooth and WLAN (Atheros 11a+b/g)
Bluetooth Model Number:	UGXZ5-102A
Bluetooth Manufacturer:	Fujitsu Ltd
WLAN Model Number:	WLL4070
WLAN Manufacturer:	Askey Computer Corp.
Interface Type:	Mini-PCI Wireless LAN Module
FCC ID:	EJE-WB0018
Industry Canada ID:	337J-WB0018
Equipment Type:	Intentional Radiator (Transceiver)

2.2 Technical Specifications

2.2.1 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

*Channels tested and reported in this report

2.2.2 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:	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
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 (M050215_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 (M050215_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 the U-NII submission (M050215_Cert_WLL4070_11abg_NII_BT)		
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

2.3 Operational Description

The EUT is a LifeBook E Series, Model: E8020D installed with a Mini-PCI Wireless LAN (WLAN) Module (Atheros 11a+b/g, Model WLL4070) & Bluetooth, Model UGXZ5-102A.

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, Model WLL4070, 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 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 Bluetooth 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:	Diconix, Model: 150, FCC ID: E759WG-RBCN150
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
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 (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
Bluetooth Module, Model UGXZ5-102A

3.0 CONDUCTED EMISSION MEASUREMENTS

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

3.1 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.

3.2 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.

3.3 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 loss in dB of the cables and the Limiter and Band pass Filter.

3.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were then concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph were subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

3.5 Results of Conducted Emission Measurements (AC Mains Ports)

Measurements were performed on the LifeBook E Series with WLAN module and Bluetooth.

Initial investigations were performed with the WLAN in all configurations (802.11b, 801.11g and 802.11a) and all modulation types: (BPSK, QPSK, 16QAM, 64QAM, DBPSK, DQPSK and CCK). No significant differences in emissions were observed. Final testing was performed while the WLAN transmitter continuously operated with configuration 802.11g on the high (Channel 11, 2462 MHz) frequency channel with the modulation rate of 6 Mbps (BPSK) 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 dBμV	QP Limit dBμV	ΔQP ±dB	Measured AV Level dBμV	AV Limit dBμV	ΔAV ±dB
0.202	Neutral	51.1	63.5	-12.4	47.8	53.5	-5.7
0.207	Active	50.9	63.3	-12.5	45.1	53.3	-8.2
0.304	Neutral	45.3	60.1	-14.8	39.0	50.1	-11.1
0.605	Neutral	41.2	56.0	-14.8	32.5	46.0	-13.5
0.430	Neutral	43.4	57.3	-13.8	28.8	47.3	-18.5
17.40	Active	45.7	60.0	-14.3	34.7	50.0	-15.3
0.611	Active	40.9	56.0	-15.1	26.9	46.0	-19.1
0.309	Active	44.2	60.0	-15.8	34.1	50.0	-15.9
17.67	Neutral	43.8	60.0	-16.2	33.5	50.0	-16.5

The worst case conducted EMI occurred at 0.202 MHz and complied with the quasi peak and average limits by margins of 12.4 dB and 5.7 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

4.0 SPURIOUS EMISSION MEASUREMENTS

4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.247(c).

Radiated emission measurements were performed to the limits as per section 15.209. 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 software for cable losses automatically corrected the measurement data for each frequency range, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

2.2 Calculation of field strength

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

E = V + AF - G + L Where:

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

- **Example Field Strength Calculation**

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

34.0 + 9.2 + 1.9 - 20 = 25.1 dBμV/m

Measurement uncertainty with a confidence interval of 95% is:

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

4.3 Radiated 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.

Testing was performed while both the Bluetooth transmitter and WLAN transmitter continuously operated. Harmonics related to the Bluetooth transmitter are reported below. For harmonics related to the WLAN transmitter, Refer to EMC Technologies' test reports: M050215_Cert_WLL4070_11abg_DTS_BT and M050215_Cert_WLL4070_11abg_NII_BT.

Measurements for the WLAN were made on a low (channel 1, 2402 MHz), middle (channel 40, 2441 MHz) and high (Channel 79, 2480 MHz) frequency channel.

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2480 MHz), was 50.1 dBμV/m peak & 35.6 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 2400 MHz when the EUT was operating at its lowest channel (2402 MHz), was 56.9 dBμV/m peak & 42.6 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

Channel 1 - 2402 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2402	Transmitter	Fundamental		-	-	
4804	53.7	40.8	Vert/Hort	74.0	54.0	Pass
7206	53.4	41.1	Vert/Hort	-	-	Pass
9608	55.9	42.4	Vert/Hort	-	-	Pass
12010	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14412	60.3	46.7	Vert/Hort	-	-	Pass
16814	63.9	49.3	Vert/Hort	-	-	Pass
19216	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21618	66.4	53.2	Vert/Hort	-	-	Pass
24020	67.8	54.7	Vert/Hort	-	-	Pass

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

Channel 40 - 2441 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2441	Transmitter	Fundamental		-	-	
4882	53.7	40.8	Vert/Hort	74.0	54.0	Pass
7323	53.4	41.1	Vert/Hort	74.0	54.0	Pass
9764	55.9	42.4	Vert/Hort	-	-	Pass
12205	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14646	60.3	46.7	Vert/Hort	-	-	Pass
17087	63.9	49.3	Vert/Hort	-	-	Pass
19528	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21969	66.4	53.2	Vert/Hort	-	-	Pass
24410	67.8	54.7	Vert/Hort	-	-	Pass

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

Channel 79 - 2480 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2480	Transmitter	Fundamental		-	-	
4960	53.7	40.8	Vert/Hort	74.0	54.0	Pass
7440	53.4	41.1	Vert/Hort	74.0	54.0	Pass
9920	55.9	42.4	Vert/Hort	-	-	Pass
12400	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14880	60.3	46.7	Vert/Hort	-	-	Pass
17360	63.9	49.3	Vert/Hort	-	-	Pass
19840	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22320	66.4	53.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24800	67.8	54.7	Vert/Hort	-	-	Pass

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

Result: No harmonics were recorded within the restricted bands of up to 25 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 sections 15.209 and 15.247. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

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

4.3.2.1 Configuration 802.11a (5.725 – 5.850 MHz) Normal Operating Mode with BT

WLAN - Channel 149 (5745 MHz) and BT – Channel 40 (2441 MHz)

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2877	69.8	42.5	Vert/Hort	74.0	54.0	Pass
5440	48.6	36.4	Vert/Hort	74.0	54.0	Pass
5120	47.1	35.7	Vert/Hort	74.0	54.0	Pass

WLAN - Channel 157 (5785 MHz) and BT – Channel 40 (2441 MHz)

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2899	71.2	45.7	Vert/Hort	74.0	54.0	Pass
5440	48.6	36.4	Vert/Hort	74.0	54.0	Pass
5120	47.1	35.7	Vert/Hort	74.0	54.0	Pass

WLAN - Channel 165 (5825 MHz) and BT – Channel 40 (2441 MHz)

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2911	72.7	48.3	Vert/Hort	-	-	Pass
5440	48.6	36.4	Vert/Hort	74.0	54.0	Pass
5120	47.1	35.7	Vert/Hort	74.0	54.0	Pass

Result: Spurious emissions were recorded within the restricted bands of up to 40 GHz. Emissions were complied with the FCC limits in sections 15.209 and 15.247 by a margin of 2.8 dB (peak) and 8.3 dB (average). The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.2.2 Configuration 802.11a (5.725 – 5.850 MHz) Turbo Mode with BT

WLAN - Channel 152 (5760 MHz) and BT – Channel 40 (2441 MHz)

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2878	67.0	35.8	Vert/Hort	74.0	54.0	Pass
5440	44.2	33.4	Vert/Hort	74.0	54.0	Pass
5120	42.5	32.1	Vert/Hort	74.0	54.0	Pass

WLAN - Channel 157 (5785 MHz) and BT – Channel 40 (2441 MHz)

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2899	65.8	35.1	Vert/Hort	74.0	54.0	Pass
5440	44.2	33.4	Vert/Hort	74.0	54.0	Pass
5120	42.5	32.1	Vert/Hort	74.0	54.0	Pass

Result: Spurious emissions were recorded within the restricted bands of up to 40 GHz. Emissions were complied with the FCC limits in sections 15.209 and 15.247 by a margin of 7.0 dB (peak) and 18.2 dB (average). The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.2.3 Configuration 802.11b and 802.11g (Normal Operating Mode and Turbo Mode) with BT

Result: No spurious emissions were recorded within the restricted bands of up to 25 GHz. Spurious emissions were confirmed low with both RBW and VBW reduced. Emissions were complied with the FCC limits in sections 15.209 and 15.247. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.2.4 Configuration 802.11a (5150 – 5350 MHz) Normal Operating Mode and Turbo Mode with BT

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.

4.3.3 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres.

Measurements were performed on the LifeBook E Series with WLAN module and Bluetooth.

Initial investigations were performed with the WLAN in both configurations (802.11b, 802.11g and 802.11a) and all modulation types: (BPSK, QPSK, 16QAM, 64QAM, DBPSK, DQPSK and CCK). No significant differences in emissions were observed. Final testing was performed while the WLAN transmitter continuously operated with configuration 802.11g on the high (Channel 11, 2462 MHz) frequency channel with the modulation rate of 6 Mbps (BPSK) 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.

Vertical Polarity

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
198.65	Vertical	30.0	33.0	-3.0
378.18	Vertical	31.7	35.5	-3.8
210.92	Vertical	29.0	33.0	-4.0
243.72	Vertical	31.0	35.5	-4.5
202.80	Vertical	27.8	33.0	-5.3
186.38	Vertical	27.6	33.0	-5.4
108.05	Vertical	24.8	33.0	-8.2
118.78	Vertical	22.5	33.0	-10.5
162.08	Vertical	21.5	33.0	-11.5
54.02	Vertical	17.9	29.5	-11.6
119.97	Vertical	21.1	33.0	-11.9
972.49	Vertical	22.8	43.5	-20.7

Horizontal Polarity

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
198.65	Horizontal	28.9	33.0	-4.1
202.77	Horizontal	26.4	33.0	-6.6
120.81	Horizontal	24.7	33.0	-8.3
299.33	Horizontal	26.6	35.5	-8.9
124.91	Horizontal	22.8	33.0	-10.2
129.01	Horizontal	22.6	33.0	-10.4
378.13	Horizontal	25.1	35.5	-10.4
971.24	Horizontal	25.6	43.5	-17.9

Result: The highest radiated emission peak occurred at 198.65 MHz (Vertical Polarity) and complied with FCC quasi peak limit by a margin of 3.0 dB. The measurement uncertainty in this band was ± 3.7 dB. Refer to tables above for results.

4.3.4 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.

Measurements for the WLAN were made on a low (channel 1, 2402 MHz), middle (channel 40, 2441 MHz) and high (Channel 79, 2480 MHz) frequency channel.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised.

Refer to Appendix K for Harmonics plots

Result: Complies.

4.3.5 Band Edge Measurements

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.

Testing was performed while the WLAN transmitter continuously transmitted on a low (2402 MHz) and high frequency (2480 MHz) channel.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised.

Refer to Appendix L for Band Edge plots
NB: D1 line indicates the highest level of the transmitter
D2 line indicates 20 dB limit below D1.

Result: Complies.

5.0 PEAK OUTPUT POWER - Section 15.247 (b)(1) & (3)

Testing was performed in accordance with the requirements of FCC Part 15.247(b)(3).

Measurements were performed while the Bluetooth transmitter continuously transmitted.

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

The resolution bandwidth of 1 MHz and the video bandwidth of 3 MHz were utilised.

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2402 MHz), middle (channel 40, 2441 MHz) and high (Channel 79, 2480 MHz) frequency channel.

Variation by +/- 15% of the supply voltage, in accordance with section 15.31(e), to the computer power supply power did not cause any variations to the RF output power.

Frequency MHz	P dBm	Limit dBm	P mW	Limit mW	Power Plots
2402	10.4	30	11.0	1000	Appendix M
2441	10.2	30	10.5	1000	Appendix M
2480	9.8	30	9.6	1000	Appendix M

Result: Complies.

6.0 CHANNEL BANDWIDTH & CHANNEL OCCUPANCY

Testing was carried out in accordance with the requirements of FCC Part 15.247(a)(1)(i)&(iii)

The EUT was a Frequency Hopping Spread Spectrum transmitter and operated as described in section 2 of this report.

6.1 Channel Bandwidth

In the band 2400 - 2483.5 MHz the hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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

A resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised.

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2402 MHz), middle (channel 40, 2441 MHz) and high (Channel 79, 2480 MHz) frequency channel.

Frequency MHz	Bandwidth kHz	Result	20 dB Bandwidth Plots
2402	739	Complies	Appendix J
2441	745	Complies	Appendix J
2480	733	Complies	Appendix J

6.2 Channel Occupancy

79 channels were observed operating between 2400 – 2483.5 MHz. Refer to Appendix N for number of channel plot.

The channel separation of 1 MHz was recorded. Refer to Appendix N for number of channel separation plot.

The device was observed to have a dwell time of 410.8 uS. This measurement was made on a channel using a spectrum analyser with a 0 Hz span and a sweep time of 5 mS. Refer to Appendix N for dwell time plot.

The specification allows for a dwell time not exceeding 0.4 seconds.

The maximum period is 79 channels x 0.4 seconds = 31.6 seconds

During the test the transmitter was observed to activate on average 315 times in 31.6 seconds.

The transmitter therefore occupies in one channel for 315 x 410.8uS = 0.129 seconds

Result: Complies.

7.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

Testing was performed in accordance with the requirements of FCC Part 15.247(b)(5)

Spread spectrum transmitters operating in the 2400 - 2483.5 MHz band are required to be operated in a manner that ensures that the public is not exposed to RF energy levels in accordance with CFR 47, Section 1.1307(b)(1).

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/cm^2.

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

where: Pd = power density (mW/cm^2)
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 5.0 of EMC Technologies Report No: M050215_Cert_WLL4070_11abg_DTS_BT (WLAN Module)
Maximum peak output power = 20.1 dBm = 102.3 mW
Antenna (Inverted F) gain (typical) = 1.06 dBi = 1.28 numeric
Prediction distance = 20 cm
Prediction frequency = 2462 MHz
MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm^2

The power density calculated = 0.026 mW/cm^2

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

8. 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.

9.0 COMPLIANCE STATEMENT

The LifeBook E Series, Model: E8020D 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 C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 -Operation in the frequency band 2400 - 2483.5 MHz.

The test sample also complies with the Industry Canada RSS-210 issue 5 (Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)) clause 6.2.2(o) 2400 – 2483.5 MHz Spread Spectrum requirements and the RF exposure requirements of RSS-102.

Results were as follows:

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**

The results for the WLAN Atheros module are reported separately.
Refer to EMC Technologies' test reports: M050215_Cert_WLL4070_11abg_DTS_BT (DTS) and M050215_Cert_WLL4070_11abg_NII_BT (U-NII).

TEST REPORT APPENDICES

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Attachment 1: RF Exposure Information
Attachment 2: FCC DOC for LifeBook E Series