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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:	Mini-PCI WLAN (Atheros 11a+b/g), Model: WLL4070 & Bluetooth Model: UGXZ5-102A
Report Number	M050215_Cert_WLL4070_11abg_DTS_BT
Tested for:	Fujitsu Australia Ltd.
Issue Date:	4th March 2005

NATA Accredited Laboratory
Number: 5292

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Test Sample: LifeBook E Series
Model: E8020D
Radio Modules: Mini-PCI WLAN, Model: WLL4070 (Askey Computer Corp.)
Bluetooth, Model: UGXZ5-102A (Fujitsu Ltd)

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 & 5725 – 5850 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 & 5725 – 5850 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
to
FCC PART 15 Subpart C (Section 15.247) & RSS-210

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 configurations IEEE 802.11b, IEEE 802.11g and IEEE 802.11a (DTS: 5725 – 5850 MHz) are reported in this test report.

The results for IEEE 802.11a (U-NII) and Bluetooth are reported separately.
Refer to EMC Technologies' test report: M050215_Cert_WLL4070_11abg_NII_BT (U-NII: 5150 – 5350 MHz) and M050215_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 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 and 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 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**

1.1.2 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

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: M050215_Cert_BT_WLL4070_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.

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:	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
Bluetooth Manufacturer:	Fujitsu Ltd
FCC ID:	EJE-WB0018
Industry Canada ID:	337J-WB0018
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:	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 this report

Frequency allocation and maximum output power setting for 802.11a:

Channel Number	Frequency (MHz)	Power level setting dBm
*Channels tested and reported in this report (DTS)		
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

2.2.2 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

*Channels tested and reported in the Bluetooth submission (M050215_Cert_BT_WLL4070_11abg)

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 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:	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
WLAN Module - WLL4070 (802.11b, 802.11g and 802.11a (DTS))

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.

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 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 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 M050215_Cert_BT_WLL4070_11abg.

4.3.1.1 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 11 Mbps (CCK).

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2462 MHz), was 56.4 dBμV/m peak & 46.8 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 (2412 MHz), was 69.1 dBμV/m peak & 58.5 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

Channel 1 - 2412 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2412	Transmitter	Fundamental				
4824	56.1	43.7	Vert/Hort	74.0	54.0	Pass
7236	53.4	41.1	Vert/Hort	-	-	Pass
9648	55.9	42.4	Vert/Hort	-	-	Pass
12060	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14472	60.3	46.7	Vert/Hort	74.0	54.0	Pass
16884	63.9	49.3	Vert/Hort	-	-	Pass
19296	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	66.4	53.2	Vert/Hort	-	-	Pass
24120	67.8	54.7	Vert/Hort	-	-	Pass

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

Channel 6 - 2437 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2437	Transmitter	Fundamental				
4874	56.8	44.3	Vert/Hort	74.0	54.0	Pass
7311	53.4	41.1	Vert/Hort	74.0	54.0	Pass
9748	55.9	42.4	Vert/Hort	-	-	Pass
12185	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14622	60.3	46.7	Vert/Hort	-	-	Pass
17059	63.9	49.3	Vert/Hort	-	-	Pass
19496	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	66.4	53.2	Vert/Hort	-	-	Pass
24370	67.8	54.7	Vert/Hort	-	-	Pass

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

Channel 11 - 2462 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2462	Transmitter	Fundamental				
4924	57.6	45.0	Vert/Hort	74.0	54.0	Pass
7386	53.4	41.1	Vert/Hort	74.0	54.0	Pass
9848	55.9	42.4	Vert/Hort	-	-	Pass
12310	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14772	60.3	46.7	Vert/Hort	-	-	Pass
17234	63.9	49.3	Vert/Hort	-	-	Pass
19696	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	66.4	53.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	67.8	54.7	Vert/Hort	-	-	Pass

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

Result: 2nd harmonic was recorded within the restricted bands of up to 25 GHz. Other 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 by a margin of 9.0 dB. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.1.2 Configuration 802.11g - Normal Operating Mode

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

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2462 MHz), was 74.6 dBμV/m peak & 54.1 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 (2412 MHz), was 88.5 dBμV/m peak & 65.6 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

Channel 1 - 2412 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2412	Transmitter	Fundamental				
4824	53.7	40.8	Vert/Hort	74.0	54.0	Pass
7236	53.4	41.1	Vert/Hort	-	-	Pass
9648	55.9	42.4	Vert/Hort	-	-	Pass
12060	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14472	60.3	46.7	Vert/Hort	74.0	54.0	Pass
16884	63.9	49.3	Vert/Hort	-	-	Pass
19296	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	66.4	53.2	Vert/Hort	-	-	Pass
24120	67.8	54.7	Vert/Hort	-	-	Pass

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

Channel 6 - 2437 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2437	Transmitter	Fundamental				
4874	53.7	40.8	Vert/Hort	74.0	54.0	Pass
7311	53.4	41.1	Vert/Hort	74.0	54.0	Pass
9748	55.9	42.4	Vert/Hort	-	-	Pass
12185	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14622	60.3	46.7	Vert/Hort	-	-	Pass
17059	63.9	49.3	Vert/Hort	-	-	Pass
19496	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	66.4	53.2	Vert/Hort	-	-	Pass
24370	67.8	54.7	Vert/Hort	-	-	Pass

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

Channel 11 - 2462 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2462	Transmitter	Fundamental				
4924	53.7	40.8	Vert/Hort	74.0	54.0	Pass
7386	53.4	41.1	Vert/Hort	74.0	54.0	Pass
9848	55.9	42.4	Vert/Hort	-	-	Pass
12310	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14772	60.3	46.7	Vert/Hort	-	-	Pass
17234	63.9	49.3	Vert/Hort	-	-	Pass
19696	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	66.4	53.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	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.

4.3.1.3 Configuration 802.11g - Turbo 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 108 Mbps (64QAM).

Channel 6 - 2437 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2437	Transmitter	Fundamental				
4874	53.7	40.8	Vert/Hort	74.0	54.0	Pass
7311	53.4	41.1	Vert/Hort	74.0	54.0	Pass
9748	55.9	42.4	Vert/Hort	-	-	Pass
12185	57.0	43.8	Vert/Hort	74.0	54.0	Pass
14622	60.3	46.7	Vert/Hort	-	-	Pass
17059	63.9	49.3	Vert/Hort	-	-	Pass
19496	65.0	51.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	66.4	53.2	Vert/Hort	-	-	Pass
24370	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.

4.3.1.4 Configuration 802.11a (5.725 – 5.850 MHz) 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 5850 MHz when the EUT was operating at its highest channel (5825 MHz), was 65.0 dBμV/m peak & 50.2 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5725 MHz when the EUT was operating at its lowest channel (5745 MHz), was 67.4 dBμV/m peak & 51.7 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

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	-	-	Pass
22980	65.5	50.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
28725	69.3	55.2	Vert/Hort	-	-	Pass
34470	78.7	65.0	Vert/Hort	-	-	Pass

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

Channel 157 – 5785 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
5785	Transmitter	Fundamental				
11570	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17355	64.1	49.6	Vert/Hort	-	-	Pass
23140	65.5	50.5	Vert/Hort	-	-	Pass
28925	69.3	55.2	Vert/Hort	-	-	Pass
34710	78.7	65.0	Vert/Hort	-	-	Pass

Channel 161 – 5825 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
5825	Transmitter	Fundamental				
11650	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17475	64.1	49.6	Vert/Hort	-	-	Pass
23300	65.5	50.5	Vert/Hort	-	-	Pass
29125	69.3	55.2	Vert/Hort	-	-	Pass
34950	78.7	65.0	Vert/Hort	-	-	Pass

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 sections 15.209 and 15.247. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.1.5 Configuration 802.11a (5.725 – 5.850 MHz) Turbo 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 108 Mbps (64QAM).

The field strength at 5850 MHz when the EUT was operating at its highest channel (5800 MHz), was 59.5 dBμV/m peak & 46.2 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 5725 MHz when the EUT was operating at its lowest channel (5760 MHz), was 66.8 dBμV/m peak & 51.7 dBμV/m average and was > 20 dB below the maximum field strength of the in-band carrier.

Channel 152 – 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	-	-	Pass
23040	65.5	50.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
28800	69.3	55.2	Vert/Hort	-	-	Pass
34560	78.7	65.0	Vert/Hort	-	-	Pass

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

Channel 160 – 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				
11560	57.7	44.3	Vert/Hort	74.0	54.0	Pass
17360	64.1	49.6	Vert/Hort	-	-	Pass
23160	65.5	50.5	Vert/Hort	-	-	Pass
28960	69.3	55.2	Vert/Hort	-	-	Pass
34760	78.7	65.0	Vert/Hort	-	-	Pass

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 sections 15.209 and 15.247. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

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

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.

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.

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 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.

4.3.3 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 100 kHz and the video bandwidth of 300 kHz were utilised.

4.3.3.1 Atheros (WLL4070) - Configuration 802.11a (5.725 – 5.850 GHz)

Refer to Appendix K1 for Harmonics plots

Result: Complies.

4.3.3.2 Atheros (WLL4070) - Configuration 802.11b

Refer to Appendix K2 for Harmonics plots

Result: Complies.

4.3.3.3 Atheros (WLL4070) - Configuration 802.11g

Refer to Appendix K3 for Harmonics plots

Result: Complies.

4.3.4 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.

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.

4.3.4.1 Atheros (WLL4070) - Configuration 802.11a (5.725 – 5.850 GHz)

Refer to Appendix L1 for Band Edge plots
NB: D1 line indicates the highest level of the transmitter
D2 line indicates 20 dB limit below D1.

Result: Complies.

4.3.4.2 Atheros (WLL4070) - Configuration 802.11b

Refer to Appendix L2 for Band Edge plots
NB: D1 line indicates the highest level of the transmitter
D2 line indicates 20 dB limit below D1.

Result: Complies.

4.3.4.3 Atheros (WLL4070) - Configuration 802.11g

Refer to Appendix L3 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 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 $\geq$ 1/T, where T (worst case) = 360 μS for normal operating mode and 180 μS for turbo mode).

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). No significant differences in peak output power were observed. 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	Result
5745	16.5	30	44.7	1000	Pass
5785	16.6	30	45.7	1000	Pass
5825	16.3	30	42.7	1000	Pass

Result: Complies

5.2 Configuration 802.11a - Turbo Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in peak output power were observed. 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	Result
5760	17.7	30	58.9	1000	Pass
5800	17.8	30	60.3	1000	Pass

Result: Complies

5.3 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). Peak output power with CCK modulation (rate = 11 Mbps) was observed to be slightly worst. Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK).

Frequency MHz	P dBm	Limit dBm	P mW	Limit mW	Result
2412	19.9	30	97.8	1000	Pass
2437	19.8	30	95.5	1000	Pass
2462	20.1	30	102.3	1000	Pass

Result: Complies.

5.4 Configuration 802.11g - Normal Operating Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in peak output power were observed. 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	Result
2412	19.0	30	19.0	1000	Pass
2437	18.9	30	18.9	1000	Pass
2462	19.2	30	19.2	1000	Pass

Result: Complies

5.5 Configuration 802.11g - Turbo Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in peak output power were observed. 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	Result
2437	17.3	30	53.7	1000	Pass

Result: Complies

6.0 CHANNEL BANDWIDTH

Testing was performed in accordance with the requirements of FCC Part 15.247(a)(2)

In the band 2400 - 2483.5 MHz and 5725 – 5850 MHz the minimum 6 dB bandwidth was at least 500 kHz. The 6 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 100 kHz and the video bandwidth of 300 kHz were utilised

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).

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
5745	16.4	Complies	Appendix J1
5785	16.4	Complies	Appendix J1
5825	16.4	Complies	Appendix J1

The minimum 6 dB bandwidth is at least 500 kHz

Result: Complies

6.2 Configuration 802.11a - Turbo 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 108 Mbps (64QAM).

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
5760	32.9	Complies	Appendix J1
5800	32.9	Complies	Appendix J1

The minimum 6 dB bandwidth is at least 500 kHz

Result: Complies

6.3 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). No significant differences in bandwidth were observed. Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK).

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
2412.0	10.2	Complies	Appendix J2
2437.0	10.2	Complies	Appendix J2
2462.0	10.2	Complies	Appendix J2

The minimum 6 dB bandwidth is at least 500 kHz

Result: Complies

6.4 Configuration 802.11g - Normal Operating Mode

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant differences in bandwidth were observed. Final testing was performed while the transmitter continuously operated with the modulation rate of 54 Mbps (64QAM).

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
2412.0	16.5	Complies	Appendix J3
2437.0	16.6	Complies	Appendix J3
2462.0	16.5	Complies	Appendix J3

The minimum 6 dB bandwidth is at least 500 kHz

Result: Complies

6.5 Configuration 802.11g - Turbo 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 108 Mbps (64QAM).

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
2437.0	32.8	Complies	Appendix J3

The minimum 6 dB bandwidth is at least 500 kHz

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 and 5725 – 5850 MHz 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/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 this report (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 PEAK POWER SPECTRAL DENSITY - Section 15.247(d)

Testing was performed accordance with the requirements of FCC Part 15.247(d)

The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.

The resolution bandwidth of 3 kHz and the video bandwidth of 30 kHz were utilised

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).

Frequency MHz	Level dBm	Limit dBm	Result	Spectral Density plots
5745	-13.4	8.0	Complies	Appendix M1
5785	-12.8	8.0	Complies	Appendix M1
5825	-13.6	8.0	Complies	Appendix M1

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

Result: Complies

8.2 Configuration 802.11a - Turbo 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 (64QAM).

Frequency MHz	Level dBm	Limit dBm	Result	Spectral Density plots
5760	-15.3	8.0	Complies	Appendix M1
5800	-15.7	8.0	Complies	Appendix M1

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

Result: Complies

8.3 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). No significant differences in peak power spectral density were observed. Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK).

Frequency MHz	Level dBm	Limit dBm	Result	Spectral Density plots
2412.0	-8.7	8.0	Complies	Appendix M2
2437.0	-8.3	8.0	Complies	Appendix M2
2462.0	-8.6	8.0	Complies	Appendix M2

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

Result: Complies

8.4 Configuration 802.11g - 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).

Frequency Hz	Level dBm	Limit dBm	Result	Spectral Density plots
2412.0	-8.0	8.0	Complies	Appendix M3
2437.0	-7.7	8.0	Complies	Appendix M3
2462.0	-8.7	8.0	Complies	Appendix M3

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

Result: Complies

8.5 Configuration 802.11g - Turbo 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 (64QAM).

Frequency Hz	Level dBm	Limit dBm	Result	Spectral Density plots
2437.0	- 13.0	8.0	Complies	Appendix M3

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

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 with Mini-PCI Wireless LAN Module (Atheros 11a+b/g), Model WLL4070 & Bluetooth, Model UGXZ5-102A, tested on behalf of Fujitsu Australia Ltd, **complies** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 -Operation in the frequency band 2400 - 2483.5 MHz and 5725 – 5850 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 and 5725 – 5850 MHz Spread Spectrum requirements and the RF exposure requirements of RSS-102.

Results were as follows:

WLAN Module - 802.11b, 802.11g and 802.11a (DTS: 5725 – 5850 MHz)

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**

The results for IEEE 802.11a (U-NII) and Bluetooth are reported separately.
Refer to EMC Technologies' test report: M050215_Cert_WLL4070_11abg_NII_BT (U-NII: 5150 – 5350 MHz) and M050215_Cert_BT_WLL4070_11abg (Bluetooth).

TEST REPORT APPENDICES

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