



EMC Technologies Pty Ltd
ABN 82 057 105 549
176 Harrick Road
Keilor Park Victoria Australia 3042

Ph: + 613 9365 1000
Fax: + 613 9331 7455
email: melb@emctech.com.au

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

FCC ID: PPD-AR5B97-F
Industry Canada ID: 4104A-AR5B97

Radio Module: Atheros XSPAN 802.11g/bn AR5B97 WLAN Module

Host NoteBook: LifeBook T Series
Model Numbers: T731 / TH701

Report Number: M110360_FCC_AR5B97_C2PC

Issue Date: 18th May 2011

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EMC Technologies Report No. M110360_FCC_AR5B97_C2PC
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CONTENTS

1.0	INTRODUCTION
2.0	GENERAL INFORMATION
FCC 15.247 (DTS) RESULTS	
3.0	CONDUCTED EMI MEASUREMENTS
4.0	RADIATED SPURIOUS EMI MEASUREMENTS
5.0	PEAK OUTPUT POWER
6.0	CHANNEL BANDWIDTH
7.0	PEAK POWER SPECTRAL DENSITY
8.0	RADIO FREQUENCY EXPOSURE
9.0	ANTENNA REQUIREMENT
10.0	COMPLIANCE STATEMENT
11.0	MEASUREMENT UNCERTAINTIES
12.0	TEST REPORT APPENDICES
MEASUREMENT INSTRUMENT DETAILS	
PHOTOGRAPHS	
ANTENNA INFORMATION	
FCC LABELLING DETAILS	
USER MANUAL	
RF Exposure Information	
FCC DOC for LifeBook T Series	
FCC Part 15B Test Report	

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Class II Permissive Change

Report No. M110360_FCC_AR5B97_C2PC

Radio Module: Atheros XSPAN 802.11g/bn AR5B97 WLAN Module
Manufacturer: Atheros Communications Inc

FCC ID: PPD-AR5B97-F
Industry Canada ID: 4104A-AR5B97
Equipment Type: Intentional Radiator (Transceiver)

Host Notebook: T731 / TH701 Portable LifeBook
Manufacturer: Fujitsu Ltd - Mobile Computing Division
Address: 1-1 Kamikodanaka 4-Chome, Nakahara-Ku, Kawasaki, Japan
Contact: Mr. Tsuyoshi Uchihara

Test Standards: FCC Part 15 – Radio Frequency Devices (October 2009)
FCC Part 15 Subpart C - Intentional Radiators
Section 15.247: 2400 – 2483.5 MHz & 5725 – 5850 MHz Operation Bands
ANSI C63.4 – 2003

RSS-210 Issue 8 Low Power Licence-Exempt RadioCommunication Devices Annex 8: 2400–2483.5 MHz & 5725–5850 MHz Operation Bands

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 Date: 16th May 2011

Test Engineer: Chieu Huynh - B.Eng (Hons) Electronics

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



Authorised Signatory: Chieu Huynh
Senior EMC Engineer
EMC Technologies Pty Ltd

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

1.0 INTRODUCTION

EMI testing was performed on the Atheros Half Mini-PCI Wireless LAN Module (HB97 802.11b/g/n 2x2), Model: AR5B97 installed in Portable PC Fujitsu LifeBook T Series, Model numbers: T731 / TH701.

The AR5B97 (HB97 802.11b/g/n 2x2) WLAN transmitter installed in the T731 / TH701 notebook is an Atheros Half Mini-PCI Wireless LAN Module. This module was originally certified by Atheros Communications as a modular approval under FCC ID: PPD-AR5B97-F (Canada ID: 4104A-AR5B97).

The other transmitter installed in the T731 / TH701 LifeBook is Broadcom Bluetooth Module, Model: BCM92070MD_REF6. The Bluetooth module was originally certified by Broadcom as a modular approval under FCC ID: QDS-BRCM1043 (Canada ID: 4324A-BRCM1043). This Bluetooth preapproved module, is not co-located as the WLAN and Bluetooth antennas are >5cms apart. RF exposure and labeling will be addressed by Fujitsu according to FCC multi-transmitter and modular procedures.

There are two variants of the Portable PC, Fujitsu LifeBook T Series, Model: T731 / TH701 covered in this report. One that is equipped with the modular certified low power Bluetooth transmitter with built-in antenna and one variant that does not contain Bluetooth transmitter or Bluetooth antenna. Testing was conducted on the sample that is equipped with the Bluetooth transmitter and Bluetooth antenna.

The intention of this Class II Permissive Change application is to certify AR5B97 Atheros module installed in Portable PC Fujitsu LifeBook T Series, Model: T731 / TH701. The Radio modules are installed in a controlled environment at the Fujitsu notebook production/assembly factory.

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

47 CFR, FCC 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, FCC Part 15 Subpart C - Section 15.247.

The test sample also complied with the Industry Canada RSS-210 issue 8 - Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Annex 8 and the RF exposure requirements of RSS-102.

The measurement procedure used was in accordance with ANSI C63.4-2003. The instrumentation conformed to the requirements of ANSI C63.2-1996.

1.1 Summary of Results

FCC Subpart C, Section 15.247

FCC Part 15 Subpart C Clauses	Industry Canada RSS-210 Issue 8 and RSS-Gen Clauses	Test Performed	Results
15.203	RSS-Gen (7.1.4)	Antenna Requirement	Complies
15.205	2.2 (Table 1)	Operation in Restricted Band	Complies
15.207	RSS-Gen (7.2.2)	Conducted Emissions	Note 1
15.209	RSS-Gen (6)	Radiated Emissions	Complies
15.247 (a)(2)	A8.1 (b) (d)	Channel Bandwidth	Note 2
15.247 (b)(3)	A8.4	Peak Output Power	Note 2
15.247 (c)	RSS-Gen (7.1.4)	Antenna Gain > 6 dBi	Not Applicable. Antenna gain < 6 dBi
15.247 (d)	A8.5	Out of Band Emissions	Complies
15.247 (e)	A8.2 (b)	Peak Power Spectral Density	Note 2
15.247 (f)	A8.3	Hybrid Systems (Note 3)	Not Applicable. EUT does not employ a hybrid system
15.247 (g)	A8.1	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (h)	A8.1	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (i)	RSS-Gen (5.5)	Radio Frequency Hazard	Complies

Note 1: Refer to FCC Part 15B Test Report

Note 2: Refer to original approval under FCC ID: PPD-AR5B97 (Canada ID: 4104A-AR5B97)

Note 3: Hybrid systems are those that employ a combination of both frequency hopping and digital modulations technique.

1.2 Modifications by EMC Technologies

No modifications were required.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT (WLAN) Details

Transmitter:	Half Mini-Card Wireless LAN Module
Wireless Module:	HB97 (11b/g/n) 2x2
Model Number:	AR5B97
Manufacturer:	Atheros Communication Inc,
Modulation Type:	Direct Sequence Spread Spectrum (DSSS for 802.11b) Orthogonal Frequency Division Multiplexing (OFDM for 802.11g/n)
2.4 GHz (802.11b/g/n):	CCK, DQPSK, DBPSK, BPSK, QPSK, 16QAM and 64QAM
Maximum Data Rate:	802.11b = 11Mbps 802.11g = 54Mbps 802.11n = 300 Mbps
Frequency Ranges:	2.412 –2.462 GHz for 11b/g/n
Number of Channels:	11 channels for 11b/g/n with 20 MHz bandwidth 7 channels for 11n with 40 MHz bandwidth
Antenna Types:	Nissei Inverted F (1 st , 2 nd)
Antenna gain:	Max antenna gain is less than 6 dBi. Refer antenna data provided separately
Power Supply:	3.3 VDC from PCI Express bus

Channels and Output Powers:

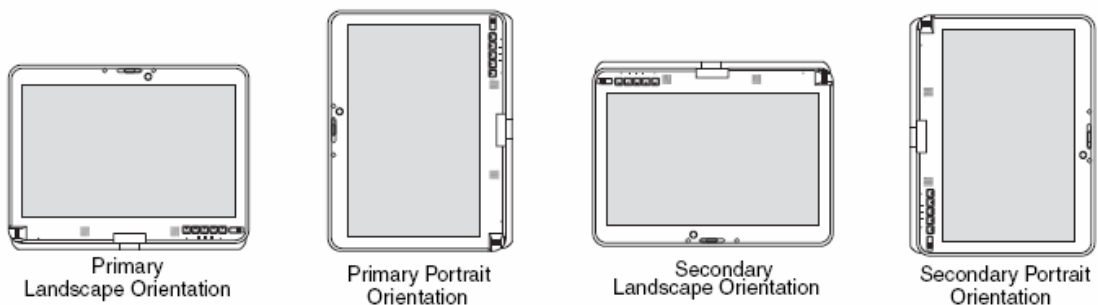
Modes	Channels	Frequency MHz	Average Output Power (dBm)
802.11b	1	2412	17.02
	6	2437	17.25
	11	2462	16.21
802.11g	1	2412	14.8
	6	2437	17.6
	11	2462	11.94
802.11n 20 MHz	1	2412	13.88
	6	2437	17.37
	11	2462	11.32
802.11n 40 MHz	3	2422	12.15
	6	2437	15.13
	9	2452	10.1

The AR5B97 is capable of using multiple antennas transmitting simultaneously (two antennas). In any two antennas transmitting, the power level is 3 dB lower (50%) for each antenna port than if a single antenna was transmitting.

2.2 Host (Notebook PC) Details

NoteBook PC:	Portable PC LifeBook T series
*Model Name:	T731 / TH701
Serial Number:	Pre-production Sample
Manufacturer:	FUJITSU LIMITED
CPU Type and Speed:	Core i7-2620M 2.7GHz
LCD:	12.1" WXGA (1280x800 : HV121WX6-100
Wired LAN:	Intel 82579LM : 10 Base-T/100 Base-TX/1000Base-T
Modem:	Agere MDC1.5 modem Model: D40
Port Replicator Model:	FPCPR105
AC Adapter Model:	80W: ADP-80NB A (Delta), SEE100P2-19.0 (Sanken), PJW1942N (Tamura), PJW1942NA (Tamura)
Voltage:	19 V
Current Specs:	4.22A
Watts:	80W

*The model numbers shown T731 and TH701 are for the same product. The difference between T731 and TH701 is color and target market.
The T731 is for commercial market.
The TH701 is for consumer market.



2.3 Test Configuration

The Atheros WLAN test software "ART" was used to transmit continuously during the tests.

Conducted tests were performed at the WLAN Antenna ports.

Radiated tests were performed for measuring the harmonics and spurious from the transmitters.

Power is provided via an AC adaptor. Testing was performed at a voltage of 110VAC at 50Hz.

2.4 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 1 and 3 metres from the EUT.

2.5 Test Facility

2.5.1 General

EMC Technologies Pty Ltd is listed by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies is listed as an FCC part 47CFR2.948 test lab and may perform the testing required under Parts 15 and 18 – **FCC Registration Number 90560**

EMC Technologies Pty Ltd has also been accredited as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 & 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

EMC Technologies has also been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS 212, Issue 1 (Provisional) - **Industry Canada number 3569B.**

Measurements were performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia.

2.5.2 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 emissions, 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 Institute (NMI) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A²LA).

2.6 Test Equipment Calibration

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 Institute (NMI). All equipment calibration is traceable to Australia national standards at the National Measurements Institute. The reference antenna calibration was performed by NMI and the working antennas (biconical and log-periodic) calibrated by the EMC Technologies. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in Appendix A

FCC 15.247 (DTS) RESULTS

3.0 CONDUCTED EMISSION MEASUREMENTS

Testing was performed by Fujitsu General EMC Laboratory, JAPAN accredited by NVLAP (Lab Code: 200373-0).

4.0 RADIATED SPURIOUS EMISSION MEASUREMENTS

4.1 Test Procedure

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

Radiated emission measurements were performed to the limits as per section 15.209 and 15.247. All measurements above 1 GHz were made over a distance of 3 and 1 metres.

Calibrated EMCO 3115, EMCO 3116 and ETS standard gain horn antennas were used for measurements between 1 to 40 GHz.

The measurement of emissions above 1000 MHz was measured using a following setting:

Peak measurements setting: RBW = VBW = 1 MHz

Average measurements setting: RBW = 1 MHz and VBW = 10 Hz

The receiver bandwidth was set to 6 dB.

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 Peak/Average Detectors. The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. 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 dB μ V/m.

V = EMI Receiver Voltage in dB μ V. (measured value)

AF = Antenna Factor in dB(m⁻¹). (stored as a data array)

G = Preamplifier Gain in dB. (stored as a data array)

L = Cable loss in dB. (stored as a data array of Insertion Loss versus frequency)

- **Example Field Strength Calculation**

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

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

4.3 Radiated Emissions (Spurious and Harmonics)

This transmitter module was originally tested and certified by the manufacturer as a stand-alone module outside a laptop (host) with higher gain antennas. Refer to manufacturer's original FCC 15.247 (FCC ID: PPD-AR5B97-F) test report for full results showing compliance with the spurious and harmonics limits. However, to ensure the transmitter module install in T731 / TH701 LifeBook is still in compliance, verification tests were performed at the worst case (frequencies with higher average output power) or selected frequencies for harmonics and spurious emissions.

Initial investigations were performed with all data rates. Final testing was performed while the transmitter continuously operated in the worst case condition.

All orientations were investigated and tested. Worst results were reported below.

4.3.1 Frequency Band: 1 – 25 GHz

The 74 dB μ V/m @ 3m and 54 dB μ V/m @ 3m limits are applied for emissions fall in the restricted bands. The limits for emission outside the restricted band are 20 dB below the fundamental field strength. The limits are adjusted by 10.5 dB when measurements perform at a distance of 1m.

Testing was performed while the WLAN transmitter continuously operated. Measurements were performed with the EUT operating in the worst case mode of single antenna transmitting. For multiple antennas transmitting like two antennas transmitting, the power level is 3 dB lower (50%) with respect to single antenna mode.

Harmonics were measured for channels where the average output power was highest.

4.3.1.1 Configuration 802.11b

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2437	Transmit Frequency				
4874	67.1	56.4	84.5	64.5	Complied

*Measurement was performed at a distance of 1m. The limit was added by 10.5dB.

Result: Harmonic was recorded up to 25 GHz. Other harmonics were confirmed low with both RBW and VBW reduced. The worst case emissions complied with the FCC limits of sections 15.209 and 15.247 by a margin of 8.1 dB.

4.3.1.2 Configuration 802.11g

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2437	Transmit Frequency				
4874	65.8	51.3	84.5	64.5	Complied

*Measurement was performed at a distance of 1m. The limit was added by 10.5dB.

Result: Harmonic was recorded up to 25 GHz. Other harmonics were confirmed low with both RBW and VBW reduced. The worst case emissions complied with the FCC limits of sections 15.209 and 15.247 by a margin of 13.2 dB.

4.3.1.3 Configuration 802.11n – Tx BW = 20 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2437	Transmit Frequency				
4874	64.6	49.9	84.5	64.5	Complied

*Measurement was performed at a distance of 1m. The limit was added by 10.5dB.

Result: Harmonic was recorded up to 25 GHz. Other harmonics were confirmed low with both RBW and VBW reduced. The worst case emissions complied with the FCC limits of sections 15.209 and 15.247 by a margin of 14.6 dB.

4.3.1.4 Configuration 802.11n – Tx BW = 40 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2437	Transmit Frequency				
4874	Lower than 6 Mbps (802.11g)				Complied

Result: Harmonic was recorded up to 25 GHz. Other harmonics were confirmed low with both RBW and VBW reduced. The worst case emissions complied with the FCC limits of sections 15.209 and 15.247 by a margin of greater than 15 dB.

4.3.2 Frequency Band: 30 - 1000 MHz

Testing was performed by Fujitsu General EMC Laboratory, JAPAN accredited by NVLAP (Lab Code: 200373-0).

4.3.3 RF Conducted Measurements at the Antenna Terminal (including Band Edge)

Refer to original approval under FCC ID: PPD-AR5B97 (Canada ID: 4104A-AR5B97) certified by Atheros.

Testing was performed by Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch.

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

Refer to original approval under FCC ID: PPD-AR5B97 (Canada ID: 4104A-AR5B97) certified by Atheros.

Testing was performed by Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch.

6.0 CHANNEL BANDWIDTH

Refer to original approval under FCC ID: PPD-AR5B97 (Canada ID: 4104A-AR5B97) certified by Atheros.

Testing was performed by Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch.

7.0 PEAK POWER SPECTRAL DENSITY

Refer to original approval under FCC ID: PPD-AR5B97 (Canada ID: 4104A-AR5B97) certified by Atheros.

Testing was performed by Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch.

8.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

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

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).

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

SAR testing was performed in accordance with OET Bulletin 65 and reported under EMC Technologies reports M110363_FCC_AR5B97_SAR_2.4 (2.4 GHz). SAR values of 1.18 mW/g was measured which complied with the FCC human exposure requirements of 47 CFR 2.1093(d).

9.0 ANTENNA REQUIREMENT

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 Atheros Half Mini-PCI Wireless LAN Module (HB97 802.11b/g/n 2x2), Model: AR5B97 installed in Portable PC Fujitsu LifeBook T Series, Model: T731 / TH701, **complied** 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 complied with the Industry Canada RSS-210 issue 8 - Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Annex 8 and the RF exposure requirements of RSS-102.

Results were as follows:

FCC Subpart C, Section 15.247

FCC Part 15 Subpart C Clauses	Industry Canada RSS-210 Issue 8 and RSS-Gen Clauses	Test Performed	Results
15.203	RSS-Gen (7.1.4)	Antenna Requirement	Complies
15.205	2.2 (Table 1)	Operation in Restricted Band	Complies
15.207	RSS-Gen (7.2.2)	Conducted Emissions	Note 1
15.209	RSS-Gen (6)	Radiated Emissions	Complies
15.247 (a)(2)	A8.1 (b) (d)	Channel Bandwidth	Note 2
15.247 (b)(3)	A8.4	Peak Output Power	Note 2
15.247 (c)	RSS-Gen (7.1.4)	Antenna Gain > 6 dBi	Not Applicable. Antenna gain < 6 dBi
15.247 (d)	A8.5	Out of Band Emissions	Complies
15.247 (e)	A8.2 (b)	Peak Power Spectral Density	Note 2
15.247 (f)	A8.3	Hybrid Systems (Note 3)	Not Applicable. EUT does not employ a hybrid system
15.247 (g)	A8.1	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (h)	A8.1	Frequency Hopping	Not Applicable. EUT does not employ frequency hopping
15.247 (i)	RSS-Gen (5.5)	Radio Frequency Hazard	Complies

Note 1: Refer to FCC Part 15B Test Report

Note 2: Refer to original approval under FCC ID: PPD-AR5B97 (Canada ID: 4104A-AR5B97)

Note 3: Hybrid systems are those that employ a combination of both frequency hopping and digital modulations technique.

11.0 MEASUREMENT UNCERTAINTIES

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainties for emissions tests shown within this report are as follows:

Conducted Emissions:	9 kHz to 30 MHz	±3.2 dB
Radiated Emissions:	30 MHz to 300 MHz	±5.1 dB
	300 MHz to 1000 MHz	±4.7 dB
	1 GHz to 18 GHz	±4.6 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

12.0 TEST REPORT APPENDICES

MEASUREMENT INSTRUMENT DETAILS

PHOTOGRAPHS

ANTENNA INFORMATION

FCC LABELLING DETAILS

USER MANUAL

RF Exposure Information

FCC DOC for LifeBook T Series

FCC Part 15B Test Report