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**EMI TEST REPORT
for
CERTIFICATION to
FCC PART 15.247 & RSS 210**

FCC ID: QK3-WL0002-1
Industry Canada ID: IC-337H-WL0002-1
Test Sample: Mini-PCI Wireless LAN Module
Wireless Module: Broadcom
Model Number: WLL3010
Tested for: Fujitsu Australia Ltd
Report Number: M030402R_Certification_Comet2
(Replacement for Report Number M030402_Certification_Comet2)

Issue Date: 30th April 2003

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NATA Accredited Laboratory
Number: 5292

**EMI TEST REPORT FOR CERTIFICATION
to
FCC Part 15.247/RSS-210**

EMC Technologies Report No. M030402R_Certification_Comet2

Issue Date: 30th April 2003

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EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15.247/RSS-210

Report Number: M030402R_Certification_Comet2

Test Sample: Mini-PCI Wireless LAN Module
Wireless Module: Broadcom
Model Number: WLL3010
Manufacturer: Askey Computer Corp.

FCC ID: QK3-WL0002-1
Industry Canada ID: IC-337H-WL0002-1

Tested for: Fujitsu Australia Ltd
Address: 5 Lakeside Drive,
Burwood East, VIC 3151 Australia
Phone: +613 9845 4300
Fax: +613 9845 4600

Responsible Party: Mr Praveen Rao
Senior Compliance Engineer

Equipment Type: Intentional Radiator (Transmitter)

Test Standards: FCC Part 15, Subpart C - Intentional Radiators
FCC Part 15.247 2400 - 2483.5 MHz Operation Band
FCC Part 15.205 Operation in Restricted Bands
FCC Part 15.207 Conducted Emissions
FCC Part 15.209 Radiated Emissions
ANSI C63.4-1992
OET Bulletin No. 63

RSS 210 Issue 5 Low Power Licence-Exempt
RadioCommunication Devices 6.2.2 (o) 2400 – 2483.5 MHz
Spread Spectrum Devices

Test Dates: 2 - 14th April 200

Test Officer: 
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 Signature: 
Chris Zombolas
Technical Director
EMC Technologies Pty Ltd



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EMI TEST REPORT FOR CERTIFICATION to FCC PART 15.247/RSS-210

1.0 INTRODUCTION

This report details the results of EMI tests and measurements performed on the Mini-PCI Wireless LAN Module (Broadcom), Model WLL3010 in accordance with the Federal Communications Commission (FCC) regulations as detailed in Title 47 CFR, Part 15 Subpart C Rules for intentional radiators, particularly Section 15.247 (Operation in the frequency band 2400 - 2483.5 MHz).

The results and technical details of the test sample are detailed in this report. The test sample **complies** with the requirements of 47 CFR, Part 15 Subpart C - Radio Frequency Devices (intentional radiators), Section 15.247.

It also complies with the Industry Canada RSS-210 issue 5 (Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)) clauses 6.2.2(o) requirements.

1.1 Summary of Results

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 Bandwidth	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 Occupancy/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 Transmissions	Complies
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	Complies

The measurement procedure used was in accordance with ANSI C63.4-1992 and OET Bulletin No. 96-43. The instrumentation conformed to the requirements of ANSI C63.2-1987.

1.2 Modifications by EMC Technologies

No modifications were required.



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2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample: Mini-PCI Wireless LAN Module (Transceiver)
Wireless Module: Broadcom
Model Number: WLL3010
Interface Type: Mini-PCI Module
FCC ID: QK3-WL0002-1
Industry Canada ID: IC-337H-WL0002-1
Equipment Type: Intentional Radiator (Transceiver)

2.2 Test Sample Operational Description

The EUT is a Mini-PCI Wireless LAN (WLAN) Module (Broadcom WLL3010) for Fujitsu Notebook PCs (LifeBooks). The Broadcom module is an OEM product from ASKEY Computer Corp., which is already certified by FCC ID: H8NWLL3010 and **re-certified by Fujitsu with FCC ID: QK3-WL0002 and Canada ID: IC-337H-WL0002**

The intention of this application is to certify the Broadcom WLAN module for LifeBook model Comet2 with Inverted F Antenna located at the hinge of the LCD screen.

2.3 Technical Specifications

Wireless Module: Broadcom
Model Number: WLL3010
Interface Type: Mini-PCI Module
Network Standards: IEEE 802.11b and IEEE 802.11g draft standard (54G)
Modulation Type: Direct Sequence Spread Spectrum (DSSS for 802.11b) and Orthogonal Frequency Division Multiplexing (OFDM for 802.11g)
Maximum Data Rate: 802.11b = 11Mbps and 802.11g = 54Mbps
Frequency Range: 2400 MHz to 2483.5 MHz
Number of Channels: 13 maximum (Only 11 channels operative in North America)
Antenna Type: Inverted "F" Antenna
Output Power: 802.11b (DSSS) = 14.96 dBm, 802.11g (OFDM) = 14.89 dBm
Power Supply: 3.3 VDC from PCI bus

EUT Host Details:

Broadcom with Inverted F Antenna

Test Sample: LIFEBOOK N Series
Model Name: N3010
Codename: Comet2
CPU Speed: 2.8 GHz
Manufacturer: Fujitsu Ltd.
AC Adapter Model: CP163061-01 / SEC150P2-19.0
 19VDC, 6.32A, 120W

2.4 Test sample configuration

The Broadcom module will normally be configured with OFDM (latest technology, 54Mbps) but is also down compatible with DSSS (11Mbps). Tests were performed in both configurations and the worst case results are reported.

Refer to Appendix B - Test Setup Photographs.



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2.5 Test Sample Block Diagram

Refer to Appendix C – EUT Specification Block Diagram

2.6 Test Sample Support Equipment

External Monitor/s:	
Conducted EMI	Videocom Model: DCM-1588VA FCC ID: H79DCM-1588
Radiated EMI	Tatung, Model No. CMITMC5, S/N 23490103 FCC ID: BJMCM15MC
USB Floppy Drives:	Fujitsu Model: FPCFDD11, P/N CP032173-01 Fujitsu Model: FPCFDD12, P/N CP078720-01
Headphones:	Verbatim Multimedia Stereo headset
LAN Hub:	Kingston SOHO Hub Model: KNE8TP/H (FCC ID: JICKNE8TP-HO)
PCMCIA Slot:	8 MB flash card, Kingmax ATA008M
USB Mouse:	Microsoft Intellimouse, S/N 00723014, FCC ID: C3KKS9
USB Scanner:	Rapidscan Mobile Colour scanner, M/N FPCSCN01, S/N DF1700100

2.7 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-1992. Radiated emissions tests were performed at a distance of 3 and 10 metres from the EUT. OET Bulletin 63 dated October 1993 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).”



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

NATA is the Australian national laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Laboratory (NML) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A²LA).

2.9 Units of Measurements

2.9.1 Conducted Emissions

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

2.9.2 Radiated Emissions

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

2.10 Test Equipment Calibration

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

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.



3.0 CONDUCTED EMISSION MEASUREMENTS

Testing was carried out in accordance with the requirements of FCC Part 15.207

3.1 Test Procedure

The arrangement specified in ANSI C63.4-1992 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 C63.2-1987 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 dB μ V to be compared to the limit.
VRx = the Voltage in dB μ V read directly at the EMI receiver.
LBPf = the insertion loss in dB of the cables and the Limiter and 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 was 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)

Frequency MHz	Line	Measured QP Level dB μ V	QP Limit dB μ V	Δ QP \pm dB	Measured AV Level dB μ V	AV Limit dB μ V	Δ AV \pm dB
0.408	Neutral	36.7	57.7	-21.0	20.5	47.7	-27.2
0.274	Neutral	39.3	61.0	-21.7	24.4	51.0	-26.6
0.407	Active	32.2	57.7	-25.5	16.5	47.7	-31.2
10.17	Active	33.6	60.0	-26.4	27.1	50.0	-22.9

The worst case conducted EMI occurred at 0.408 MHz and complied with the quasi peak and average limits by margins of 21.0 dB and 27.2 dB respectively. The measurement uncertainty was ± 2.0 dB. Refer to graphs 1 and 2 in Appendix G for plots of the conducted EMI measurements.



4.0 RADIATED EMISSION MEASUREMENTS

4.1 Test Procedure

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 and HP8449B preamplifier were used for measurements between 1 to 25 GHz.

Testing was performed at a distance of 10 metres for the frequency ranges 30 to 1000 MHz and 3 metres for the frequency range 1 to 25 GHz.

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two antenna heights. Each significant peak was then investigated and maximised with the Quasi-Peak detector. The measurement data for each frequency range was automatically corrected by the software for cable losses, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

Calculation of Field Strength

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

$$E = V + AF - G + L$$

Where:

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

• Example Field Strength Calculation

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

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



4.2 Section 15.247 (c) Out of Band Emissions (Spurious and Harmonics)

Testing was carried out in accordance with the requirements of FCC Part 15.247(c).
As the transmitter has no external connections measurements were made at the open area test site.

Testing was carried while transmitter continuously on a low, middle and high frequency channel.

The device was placed on the test table, being 0.8 m above the ground plane, with the front display facing the test antenna.

Measurements were made using a resolution bandwidth of 100 kHz where an emission fell outside of a restricted band.

When an emission fell within a restricted band an average detector with a resolution bandwidth of 1 MHz was utilised.

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

All measurements have been made in absolute field strength $\mu\text{V/m}$ which has been converted to $\text{dB}\mu\text{V/m}$.

The 54 $\text{dB}\mu\text{V/m}$ limit at 3 metres has been converted to 64 $\text{dB}\mu\text{V/m}$ at 1 metre using a factor of 20 dB per decade where emissions are located in the restricted bands.

In the unrestricted bands measurements were made to determine if the field strength of the emissions observed were more than 20 dB down on the fundamental.

Radiated emission measurements are required to be carried out with the limits as per section 15.209 applied.

The measurement of emissions above 1000 MHz, that appear in the restricted bands, was made using an average detector with a bandwidth of 1.0 MHz.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height.

The emission is measured in both vertical and horizontal antenna polarisations.

The emission level is determined in field strength by taking the following into consideration:

$$\text{Level (dB}\mu\text{V/m)} = \text{Receiver Reading (dB}\mu\text{V)} + \text{Antenna Factor (dB)} + \text{Coax Loss (dB)} - \text{Preamplifier Gain (dB)}$$

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests $(1000 \text{ MHz} - 18,000 \text{ MHz}) \pm 4.1 \text{ dB}$
 $(30 \text{ MHz} - 1,000 \text{ MHz}) \pm 3.7 \text{ dB}$



4.2.1 Frequency Band: 1 – 25 GHz

All recorded emissions complied with the FCC limit. No harmonics were recorded within the restricted bands of up to 25 GHz. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions was ± 4.1 dB.

The field strength at 2483.5 MHz when the EUT is operating at its highest channel (2462 MHz), is <38 dBuV/m (noise floor) and is > 20 dB below the maximum field strength of the in-band carrier.

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2412	94.7	-	Vert	-	-	Pass
4824	45.5	34.7	Vert/Hort	74.0	54.0	Pass
7236	49.6	36.9	Vert/Hort	74.0	54.0	Pass
9648	52.8	39.6	Vert/Hort	-	-	Pass
12060	55.2	41.6	Vert/Hort	74.0	54.0	Pass
14472	58.7	45.2	Vert/Hort	74.0	54.0	Pass
16884	62.1	47.5	Vert/Hort	74.0	54.0	Pass
19296	64.2	51.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	68.5	55.9	Vert/Hort	-	-	Pass
24120	68.7	56.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2437	94.2	-	Vert	-	-	Pass
4874	45.2	32.7	Vert/Hort	74.0	54.0	Pass
7311	48.6	37.0	Vert/Hort	74.0	54.0	Pass
9748	54.0	39.8	Vert/Hort	-	-	Pass
12185	55.2	42.0	Vert/Hort	74.0	54.0	Pass
14622	58.7	45.0	Vert/Hort	-	-	Pass
17059	62.1	48.8	Vert/Hort	74.0	54.0	Pass
19496	66.5	52.8	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	67.7	55.5	Vert/Hort	-	-	Pass
24370	68.7	55.8	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass



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Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2462	94.0	-	Vert	-	-	Pass
4924	45.0	32.5	Vert/Hort	74.0	54.0	Pass
7386	49.5	37.1	Vert/Hort	74.0	54.0	Pass
9848	53.3	39.5	Vert/Hort	-	-	Pass
12310	55.5	42.0	Vert/Hort	74.0	54.0	Pass
14772	58.5	44.4	Vert/Hort	-	-	Pass
17234	62.3	50.0	Vert/Hort	74.0	54.0	Pass
19696	65.8	52.9	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	67.7	55.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	68.7	55.9	Vert/Hort	-	-	Pass

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

No further emissions detected.

Result: Complies



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4.2.2 Frequency Band: 30 - 1000 MHz

Frequency MHz	Polarisation	QP Measured dB μ V	QP Limit dB μ V	Δ QP \pm dB
48.03	Vertical	28.7	30.0	-1.3*
48.01	Horizontal	27.2	30.0	-2.8*
50.78	Vertical	26.2	30.0	-3.8
53.54	Vertical	24.6	30.0	-5.4
42.03	Vertical	23.8	30.0	-6.2
60.01	Vertical	22.4	30.0	-7.6
54.65	Horizontal	22.3	30.0	-7.7
160.1	Vertical	24.8	33.5	-8.7

*Note: result within the band of measurement uncertainty around the limit.

Result : The highest radiated emission peak complied with FCC limit by a margin of 1.3 dB at 48.03 MHz. The measurement uncertainty for radiated EMI was ± 3.7 dB.

Result: Complies

4.3 Section 15.247 (a)(2) - Channel Bandwidth

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

The EUT was a Direct Sequence Spread Spectrum transmitter using digital modulation techniques and operated as described in section 2 of this report.

In the band 2400 - 2483.5 MHz the minimum 6 dB bandwidth was at least 500 kHz. The -6 dB bandwidth was measured at 2412, 2437 and 2462 MHz which equated to low, middle and top frequencies using a spectrum analyser in peak hold mode and a horn antenna.

A resolution bandwidth of 300 kHz was utilised.

The 6 dB bandwidth for these 3 frequencies was determined to be:

Frequency MHz	Bandwidth MHz	Result
2412.0	11.63	Complies
2437.0	11.63	Complies
2462.0	11.38	Complies

Refer to Appendix H for Channel Bandwidth plots.

Result: Complies.



4.4 Section 15.247 (b)(3)& (4) - Peak Output Power

Testing was carried out in accordance with the requirements of FCC Part 15.247(b)(3)

The device was placed on the test table, being 80 cm above the ground plane, with the computer screen display facing the test antenna located 3 metre away.

Measurements were made with the spectrum analyser operating in peak hold mode with a resolution bandwidth of 3 MHz.

The power envelope of the device was determined with the antenna using vertical and horizontal polarisations,

The power envelope was maximised by rotating the device using a turntable and by height scanning between 1 – 4 metres using the automated antenna tower.

As the bandwidth of the emission exceeded the resolution bandwidth of the spectrum analyser power measurements were made in 3 MHz steps across the frequency band occupied by the emission that were then summed using a spreadsheet.

Each of these emissions were recorded in dBuV and were then converted to dBm and subsequently into an absolute power level (mW).

Each of these individual power levels was then summed to give a total envelope power for the emission.

The total envelope power in mW was then converted to dBm.

The radiated power was then determined by adding factors for the cable losses, antenna gains, path loss and the preamplifier gain.

Measurements were made on a low, middle and high frequency channel

Example calculation - Low Channel – 2412 MHz

Freq MHz	Level dBuV	Level dBm	Level uW	Total Power mW	Total Power dBm	Ant Gain dB	Coax Loss dB	Preamp Gain dB	Path Loss dB	Power dBm	Power mW
2403	99.44	-7.6	175								
2406	98.83	-8.2	152								
2409	99.85	-7.2	193								
2412	99.32	-7.7	171	1.06	0.26	9.8	9.5	35	49.6	14.6	29.0
2415	99.24	-7.8	167								
2418	98.5	-8.5	141								
2421	94.59	-12.4	57								

The specification limit is 30 dBm (1.0W).

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

This device has no external antenna port with the antenna being located internally.



Frequency MHz	Level mW	Limit mW	Result
2412.0	26.0	1000	Complies
2437.0	22.1	1000	Complies
2462.0	24.5	1000	Complies

The specification limit is 1W (30 dBm).

Result: Complies.

4.5 Section 15.247(b)(5) - Radio Frequency Exposure (Hazard) Information

Testing was carried out 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).

In accordance with this section and also section 2.1091 this device has been defined as a portable device whereby a distance of 20 cm can normally be maintained between the user and the device.

In accordance with Section 1.1310, the Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure of 1.0 has been applied, i.e 1mW/cm².

The maximum distance from the antenna at which the MPE is met or exceeded is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain and separation distance in metres:

$$E, \text{ V/m} = (\sqrt{30 * P * G}) / d$$

$$\text{Power density, mW/m}^2 = E^2 / 3770$$

$$\begin{aligned} E \text{ for MPE: } &= E^2 / 3770 \\ E &= \sqrt{1 * 3770} \\ E &= 61.4 \text{ V/m} \end{aligned}$$

The maximum transmitter power measured = 14.1 dBm or 26.0 milliwatts.

$$\begin{aligned} d &= \sqrt{(30 * P * G) / E} \\ &= \sqrt{(30 * 0.026) / 61.4} \\ &= 0.0144 \text{ metres or } 1.4 \text{ cm} \end{aligned}$$

Calculation show that this device with described antenna meets the MPE requirements for portable devices falling below the 20 cm clearance required.

Result: Complies.



4.6 Section 15.247(d) - Peak Power Spectral Density

Testing was carried out in accordance with the requirements of FCC Part 15.247(d)

The device was placed on the test table, being 80 cm above the ground plane, with the computer screen display facing the test antenna located 3 metres away.

Measurements were made with the spectrum analyser operating in peak hold mode with a resolution bandwidth of 3 kHz

The maximum peak power spectral density was determined with the antenna using vertical and horizontal polarisations and when the device was rotated by using a turntable and it was height scanned between 1 – 4 metres using an automated antenna tower.

The peak power spectral density was then determined by adding factors for the cable losses, antenna gains, path loss and the preamplifier gain.

Measurements were made on a low, middle and high frequency channel

Example Calculation

Freq MHz	Level dBuV	Level dBm	Ant Gain dB	Coax Loss dB	Preamp Gain dB	Path Loss dB	Power dBm	Antenna Polarisation
2408.23	76.15	-30.9	9.8	9.5	35	49.6	-15.4	Vertical
2407.94	73.45	-33.6	9.8	9.5	35	49.6	-18.1	Horizontal

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

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.

This device has no external antenna port with the antenna being located internally.

Frequency MHz	Level dBm	Limit dBm	Result
2412.0	-12.2	8.0	Complies
2437.0	-13.9	8.0	Complies
2462.0	-13.3	8.0	Complies

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

Result: Complies.



5.0 COMPLIANCE STATEMENT

The Mini-PCI Wireless LAN Module (Broadcom), Model WLL3010, 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.

It also complies with the requirements of Industry Canada RSS 210 Issue 5 section 6.2.2 (o).

Results were as follows:

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 Bandwidth	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 Occupancy/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 Transmissions	Complies
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	Complies



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APPENDIX A**MEASUREMENT INSTRUMENTATION DETAILS**

EQUIPMENT TYPE	MAKE/MODEL SERIAL NUMBER	LAST CAL. DD/MM/YY	DUE DATE DD/MM/YY	CAL. INTERVAL
EMI RECEIVER	HP 8546A Sn.3549A00290 EMI Receiver	13/01/03	13/03/04	1 YEAR *2
EMI RECEIVER	HP 8574B System Components	12/02/03	12/02/04	1 YEAR *2
SPECTRUM ANALYSER	HP8593EM Sn. 3146A-01297 9 kHz –26 GHz	23/05/02	23/05/03	1 YEAR *2
ANTENNAS	EMCO 93110B BICONICAL 20 - 300 MHz Sn. 9804-3092	07/08/02	07/08/03	1 YEAR *3
	EMCO 93146A LOG PERIODIC 300 -1000MHz Sn. 5033	26/07/02	26/07/03	1 YEAR *3
	EMCO 3115 DOUBLE RIDGED HORN 1 - 18 GHz Sn: 8908-3282	29/01/03	29/01/04	1 YEAR *3
	EMCO 3116 Double Ridged Guide Horn 18 – 40 GHz Sn 2276	22/08/02	22/01/04	2 YEARS *1
PREAMPLIFIER	HP 8449B PREAMPLIFIER 1 - 26.5 GHz (30 dB Gain) Sn: 3008A01113	29/05/02	29/05/03	1 YEAR *3
LISN	EMCO 3825/2 50ohm / 50 microH 0.009 – 30MHz Sn.9607-2567	10/02/03	10/02/04	1 YEAR *3

Note *1. National Measurements Laboratory calibration.

Note *2. NATA calibration by Agilent Technologies (Aust) Pty Ltd

Note *3. In-house calibration. Refer to Quality Manual.

TEST SITES

Shielded Room Test Laboratory	Melbourne 11m x 8m x 4m Chamber-semi-anechoic 8.8m x 5.8m x 3.1m Test Chamber 3.4m x 6.1m x 2.5m Test Chamber 3.4m x 7.3m x 7.5m Test Chamber	Feb 03 N/A N/A N/A	Feb 04 N/A N/A N/A	1 Year *1 N/A N/A N/A
Open Area Test Site	Melbourne 3/10 Metre site. 1-4 metre antenna mast. 1.2 metre/400 kg Turntable. (Situated at Lerderderg Gorge, near Bacchus Marsh, Victoria)	21/01/03	21/01/04	1 Year *1

Note *1. In-house calibration. Refer to Quality Manual.



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APPENDIX B

TEST SAMPLE PHOTOGRAPHS

SUBMITTED AS ATTACHMENT



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APPENDIX C

EUT SPECIFICATION (BLOCK DIAGRAM)

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APPENDIX D
FCC ID LABELING

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APPENDIX E

TEST SAMPLE SCHEMATICS

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APPENDIX F

PCB LAYOUTS

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APPENDIX G

GRAPHS OF EMI MEASUREMENTS

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APPENDIX H

CHANNEL BANDWIDTH PLOTS

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APPENDIX I
ANTENNA INFORMATION (INVERTED F)

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APPENDIX J

USER MANUAL (COPY OF USER MANUAL SUPPLIED TO END USERS)

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