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

FCC ID:	**EJE-WL0002**
Industry Canada ID:	**IC: 337J-WL0002**
Test Sample:	Mini-PCI Wireless LAN Module
Wireless Module:	Broadcom
Model Number:	WLL3010-Mace
Tested for:	Fujitsu Australia Ltd.
Issue Date:	8th August 2003

NATA Accredited Laboratory
Number: 5292

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

EMC Technologies Report No. M030725_Certification_Mace_Broadcom

Issue Date: 8th August 2003

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

Report Number:	M030725_Certification_Mace_Broadcom
Test Sample:	Mini-PCI Wireless LAN Module
Wireless Module:	Broadcom
Model Number:	WLL3010-Mace
Manufacturer:	Askey Computer Corp.
Manufacturer (Host PC):	Fujitsu Limited
Address:	1405, Ohamaru, Inagi-shi, Tokyo 206-8503, Japan
Contact:	Kanbe Katsuhito
FCC ID:	EJE-WL0002
Industry Canada ID:	IC: 337J-WL0002
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 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 July – 5th August 2003
Test Officers:	**Chieu Huynh B. Eng (Hons) Electronics** **Janath Gunasekera BscEng., MtelcomEng, MIEEE**
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**

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

1. INTRODUCTION

This report details the results of EMI tests and measurements performed on the Mini-PCI Wireless LAN Module (Broadcom), Model WLL3010-Mace 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.

The test sample 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 and the RF exposure requirements of RSS-102.

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 Bandwidth	**Complies**
15.247 (b)(3)	6.2.2(o)(b)	Peak Output Power	**Complies**
15.247 (b)(5)		Radio Frequency Hazard	***Complies with SAR requirements**
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	**Complies**
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	**Complies**

*Refer to EMC Technologies' report M030726_Mace_Broadcom SAR Report

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.

2. 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-Mace
Interface Type:	Mini-PCI Module
FCC ID:	EJE-WL0002
Industy Canada ID:	IC: 337J-WL0002
Equipment Type:	Intentional Radiator (Transceiver)

2.2 Test Sample Operational Description

The EUT is a Mini-PCI Wireless LAN (WLAN) Module (Broadcom WLL3010-Mace) for Fujitsu Notebook PCs (Lifebooks). The Broadcom module is an OEM product from ASKEY Computer Corp., which is already certified by FCC ID: H8NWLL3010.

This Broadcom module was re-certified under modular certification FCC ID: QK3-WL0002 and IC: 337H-WL0002. Applied by EMC Technologies and FCC certification granted by Curtis - Straus LLC, (refer to Grant dated 4th April 2003 & Industry Canada Grant, dated 16th April 2003).

The intention of this application is to certify the Broadcom WLAN module for LifeBook T series – model T3010D (Mace). The Mace is a notebook/Pentablet convertible PC.
The highest CPU speed, Pentium-M 1.4 GHz model was chosen for the tests and all other Mace models which are identical to the tested model except with lower CPU speed shall be declared compliant based on this test report.

The EUT's model number WLL3010 is a generic designation of the following Broadcom module models:

1-11 inch WLL3011-D50
1-13 inch WLL3012-D50
1-14 inch WLL3010-D50

The hardware in all model types is identical. The differences are in the channel allocation. For USA and Canada, the maximum operative channels are 11.

Refer to Appendix B, Test Sample Photographs for details of WLAN and Antenna locations.

2.3 Technical Specifications

Wireless Module:	Broadcom
Model Number:	WLL3010-Mace
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:	Monopole Dielectric 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:	LIFEBOOK T Series
Model Number:	T3010D
Codename:	Mace
Serial Number:	Not Supplied
CPU Speed:	Pentium-M 1.4 GHz
Manufacturer:	Fujitsu Ltd.
SDRAM:	256MB
LCD Screen:	12.1"XGA
Hard Disk Drive:	60 GB
LAN:	Realtech 10/100 Base-T (on Board)
Modem:	MBH7MD33 and MBH7MD35
Wireless LAN Module:	Broadcom with Monopole Dielectric Antenna
Port Replicator Model:	FPCPR39 or FPCPR39AP

AC Adapter: Tests performed with CA01007-0850 adapter

AC Adapter Model Number	Alternate Model Number	Adapter Spec		
		Volts	Amps	Watts
SEB80N2-16.0	CA01007-0850	16	3.75	60
UJ88	CA01007-0870			

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.

AC Adapter

The AC adapter CA01007-0850 was used for all the tests. This adapter is also identified as CA01007-0870, SEB80N2-16.0 & UJ88. The manufacturer has stated that all these adapters are identical electrically and mechanically.

Refer to Appendix B - Test Setup Photographs.

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	IPEX, Model: H566, FCC ID: GKR567
Radiated EMI	Hewlett Packard 15" Color monitor, Model D2827A, FCC ID: C5F7NFCMC1515X
USB Floppy Drives:	Fujitsu Model: FPCFDD11, P/N CP032173-01 Fujitsu Model: FPCFDD12, P/N CP078720-01
Headphones:	Verbatim Multimedia Stereo headset
USB Mouse:	Microsoft Intellimouse, P/N X05-48976, S/N 3220403
USB Keyboard:	Logitech Model: Y-BA9, S/N MCT94602411
LAN Hub:	Kingston SOHO Hub Model: KNE8TP/H (FCC ID: JICKNE8TP-HO)
PCMCIA Slot:	8 MB flash card, Kingmax ATA008M
AC Adaptor:	CA01007-0850

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)."

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 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 dBµV to be compared to the limit.
VRx = the Voltage in dBµV 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 dBµV	QP Limit dBµV	ΔQP ±dB	Measured AV Level dBµV	AV Limit dBµV	ΔAV ±dB
0.203	Active	58.4	63.5	-5.1	46.3	53.5	-7.2
0.204	Neutral	56.0	63.4	-7.4	45.4	53.4	-8.0
0.271	Active	49.2	61.1	-11.9	38.1	51.5	-13.0
0.340	Active	45.2	59.2	-14.0	35.7	49.2	-13.5
0.272	Neutral	47.0	61.1	-14.1	35.2	51.1	-15.9
21.36	Active	39.3	60.0	-20.7	32.3	50.0	-17.7

The worst case conducted EMI occurred at 0.203 MHz and complied with the quasi peak and average limits by margins of 5.1 dB and 7.2 dB respectively. The measurement uncertainty was ±2.0 dB. Refer to 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 range 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.

4.2 Calculation of field strength

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

E = V + AF - G + L

Where:

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

- **Example Field Strength Calculation**

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

34.0 + 9.2 + 1.9 - 20 = 25.1 dBµV/m

4.3 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.

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 above 1GHz 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 μV/m which has been converted to dBμV/m.

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 are located in the restricted bands.

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

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, 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:

Level (dBμV/m) = Receiver Reading (dBμV) + Antenna Factor (dB) + Coax Loss (dB) - Pre Amp (dB)

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

4.3.1 Frequency Band: 1 – 25 GHz

Testing was performed while the transmitter continuously transmitted on a low, middle and high frequency channel. Both configurations (OFDM & DSSS) were checked and no significant differences in results were noted between the two modulation types. The final test results listed below are for the worst case configuration of OFDM.

All recorded emissions complied with the FCC Class B average limit by a margin of greater than 10 dB. 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 in this band was ±4.1 dB.

The field strength at 2483.5 MHz when the EUT is operating at its highest channel (2462 MHz), is <38 dBμV/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	101.8	-	Vert	-	-	Pass
4824	45.1	32.9	Vert/Hort	74.0	54.0	Pass
7236	48.9	36.6	Vert/Hort	-	-	Pass
9648	52.9	38.9	Vert/Hort	-	-	Pass
12060	55.2	41.2	Vert/Hort	74.0	54.0	Pass
14472	58.5	44.5	Vert/Hort	74.0	54.0	Pass
16884	61.9	46.9	Vert/Hort	-	-	Pass
19296	64.3	50.1	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	66.6	53.9	Vert/Hort	-	-	Pass
24120	67.8	55.5	Vert/Hort	-	-	Pass

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2437	100.7	-	Vert	-	-	Pass
4874	45.2	32.9	Vert/Hort	74.0	54.0	Pass
7311	48.9	36.8	Vert/Hort	74.0	54.0	Pass
9748	52.7	39.2	Vert/Hort	-	-	Pass
12185	55.5	41.5	Vert/Hort	74.0	54.0	Pass
14622	58.1	44.7	Vert/Hort	-	-	Pass
17059	62.2	46.8	Vert/Hort	-	-	Pass
19496	64.4	50.3	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	66.5	53.7	Vert/Hort	-	-	Pass
24370	68.1	55.9	Vert/Hort	-	-	Pass

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2462	101.5	-	Vert	-	-	Pass
4924	45.1	32.7	Vert/Hort	74.0	54.0	Pass
7386	49.4	37.1	Vert/Hort	74.0	54.0	Pass
9848	53.3	39.3	Vert/Hort	-	-	Pass
12310	55.4	41.9	Vert/Hort	74.0	54.0	Pass
14772	58.8	44.7	Vert/Hort	-	-	Pass
17234	62.3	47.7	Vert/Hort	-	-	Pass
19696	64.9	51.3	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	66.8	53.8	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	68.5	55.4	Vert/Hort	-	-	Pass

*Measurement was performed at 1 metre distance and the limits were corrected accordingly. No further emissions detected.

Result: Complies

4.3.2 Frequency Band: 30 - 1000 MHz

Initial investigations were performed with both configurations (OFDM & DSSS). No significant differences in emissions were observed. Final testing was performed while the transmitter continuously transmitted with OFDM on the low (2412 MHz) frequency channel.

The reported frequencies in the tables were mainly concerned with the notebook emissions and not directly related to the Broadcom WLAN module emissions.

The highest radiated emission peak occurred at 623.10 MHz (Horizontal polarity) and complied with FCC quasi peak limit by a margin of 1.9 dB. The measurement uncertainty in this band was ± 3.7 dB.
Refer to tables below for results.

Vertical Polarity

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
192.07	Vertical	28.3	33.5	-5.2
86.01	Vertical	23.7	30.0	-6.3
86.02	Vertical	23.5	30.0	-6.5
625.26	Vertical	29.0	36.0	-7.0
709.21	Vertical	29.0	36.0	-7.0
31.37	Vertical	22.7	30.0	-7.3
184.34	Vertical	26.0	33.5	-7.5
359.11	Vertical	26.5	36.0	-9.5
439.75	Vertical	26.3	36.0	-9.7
443.69	Vertical	26.1	36.0	-9.9

Horizontal Polarity

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
623.10	Horizontal	34.1	36.0	-1.9
627.00	Horizontal	34.0	36.0	-2.0
441.22	Horizontal	33.6	36.0	-2.4
443.22	Horizontal	33.5	36.0	-2.5
439.71	Horizontal	32.6	36.0	-3.4
438.12	Horizontal	32.0	36.0	-4.0
707.95	Horizontal	29.6	36.0	-6.4
634.05	Horizontal	28.9	36.0	-7.1
86.02	Horizontal	21.4	30.0	-8.6
643.59	Horizontal	26.5	36.0	-9.5

Result: Complies.

4.4 Channel Bandwidth

Testing was carried out in accordance with the requirements of FCC Part 15.247(a)(2)
The EUT uses 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	Modulation Type	Bandwidth MHz	Result
2412.0	DSSS	11.4	Complies
2437.0	DSSS	11.7	Complies
2462.0	DSSS	11.6	Complies
2412.0	OFDM	16.5	Complies
2437.0	OFDM	16.7	Complies
2462.0	OFDM	16.7	Complies

Result: Complies.

Refer to Appendix H for Channel Bandwidth plots.

4.5 Section 15.247 (b)(1) & (3) - 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 with both configurations (OFDM & DSSS).

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	Modulation Type	Level mW	Limit mW	Result
2412.0	OFDM	35.1	1000	Complies
2437.0	OFDM	32.1	1000	Complies
2462.0	OFDM	33.1	1000	Complies
2412.0	DSSS	29.5	1000	Complies
2437.0	DSSS	28.5	1000	Complies
2462.0	DSSS	27.3	1000	Complies

The specification limit is 1W (30 dBm).

Result: Complies.

4.6 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 cannot 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/cm^2.

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

E, V/m = ($\sqrt{}$ (30 * P *G)) / d
Power density, mW/cm^2 = E^2/3770
E for MPE: = E^2/3770
E = $\sqrt{}$1*3770
E = 61.4 V/m

The max Antenna (Monopole Dielectric) gain = 1.0 dBi

Conducted Power
Conducted power of the device was measured after temporary modification of antenna connector inside the device's TX RX compartment. Measurements were conducted with a calibrated Power Meter. The results of this measurement are listed below.

Frequency and Output Power

Frequency MHz	Modulation	Maximum Conducted Output Power Measured
2437	OFDM	6.24dBm (4.2mW)
2437	DSSS	12.12 dBm (16.3mW)

The total power (P*G) measured at the Antenna of WLAN Module (Broadcom, WLL3010-Mace):

The maximum transmitter power measured (OFDM) = 6.24 dBm or 4.2 milliwatts.
d = $\sqrt{}$ (30 * P *G) / E
= $\sqrt{}$ (30 * 0.004) / 61.4
= 0.006 metres or 0.6 cm

The maximum transmitter power measured (DSSS) = 12.12 dBm or 16.3 milliwatts.
d = $\sqrt{}$ (30 * P *G) / E
= $\sqrt{}$ (30 * 0.016) / 61.4
= 0.011 metres or 1.1 cm

Radiated Power
The result was extracted from section 4.5 of this report.

Frequency and Output Power

Frequency MHz	Modulation	Maximum Conducted Output Power Measured
2412	OFDM	15.5 dBm (35.1mW)
2412	DSSS	14.7 dBm (29.5mW)

The total power (P*G) measured at the Antenna of WLAN Module (Broadcom, WLL3010-Mace):

The maximum transmitter power measured (OFDM) = 15.5 dBm or 35.1 milliwatts.

d = √ (30 * P *G) / E
= √ (30 * 0.035) / 61.4
= 0.017 metres or 1.7 cm

The maximum transmitter power measured (DSSS) = 14.7 dBm or 29.5 milliwatts.

d = √ (30 * P *G) / E
= √ (30 * 0.0295) / 61.4
= 0.015 metres or 1.5 cm

Conclusion:
Calculations show that this device with described antenna does not meet the MPE requirements for portable devices falling below the 20 cm clearance required, however the SAR value of 0.426 mW/g complies with the FCC human exposure requirements of 47 CFR 2.1093 (d).
Refer to EMC Technologies' report - M030726_Mace_Broadcom SAR Report for details of SAR compliance.

4.7 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	10.7	35	49.6	-15.4	Vertical
2407.94	73.45	-33.6	9.8	10.7	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	-14.6	8.0	Complies
2437.0	-14.5	8.0	Complies
2462.0	-15.4	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-Mace, 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 Bandwidth	**Complies**
15.247 (b)(3)	6.2.2(o)(b)	Peak Output Power	**Complies**
15.247 (b)(5)		Radio Frequency Hazard	***Complies with SAR requirements**
15.247 (c)	6.2.2(o)(e1)	Out of Band Emissions	**Complies**
15.247 (d)	6.2.2(o)(iv)	Peak Power Spectral Density	**Complies**

*Refer to EMC Technologies' report M030726_Mace_Broadcom SAR Report

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	13/03/03	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	13/06/03	13/06/04	1 YEAR *2
ANTENNAS	EMCO 93110B BICONICAL	07/08/02	07/08/03	1 YEAR *3
	20 - 300 MHz Sn. 9804-3092			
	EMCO 93146A LOG PERIODIC	11/07/03	11/07/04	1 YEAR *3
	200 -1000MHz Sn. 5033			
	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	22/08/02	22/08/04	2 YEARS *1
	18 – 40 GHz Sn 2276			
PREAMPLIFIER	HP 8449B PREAMPLIFIER	02/07/03	02/07/04	1 YEAR *3
	1 - 26.5 GHz (30 dB Gain) Sn: 3008A01113			
LISN	EMCO 3825/2 50ohm / 50 microH	10/02/03	10/02/04	1 YEAR *3
	0.009 – 30MHz Sn.9607-2567			

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.

TEST REPORT APPENDICES

(Submitted as attachments)

APPENDIX A: MEASUREMENT INSTRUMENT DETAILS

APPENDIX B: TEST SAMPLE PHOTOGRAPHS

APPENDIX C: EUT SPECIFICATION (BLOCK DIAGRAM)

APPENDIX D: FCC ID LABELLING

APPENDIX E: TEST SAMPLE SCHEMATICS

APPENDIX F: PCB LAYOUTS

APPENDIX G: GRAPHS of EMI MEASUREMENTS

APPENDIX H: CHANNEL BANDWIDTH PLOTS

APPENDIX I: ANTENNA INFORMATION (MONOPOLE DIELECTRIC ANTENNA)

APPENDIX J: USER MANUAL (SUPPLIED TO ALL END USERS)

APPENDIX K: EUT HOST SPECIFICATIONS

APPENDIX L: EUT HOST USER MANUAL