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

FCC ID:	**EJE-WB0004**
Industry Canada ID:	**337J-WB0004**
Test Sample:	Mini-PCI WLAN (Calexico2 11b/g) and Bluetooth Module
WLAN Model:	WM3B2200BG
Bluetooth Model:	UGXZ5-102A
Report Number	M040126_Cert_Onion_Calexico2_BT
Tested for:	Fujitsu Australia Ltd.
Issue Date:	20th February 2004

NATA Accredited Laboratory
Number: 5292

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CONTENTS

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Test Sample:	Mini-PCI WLAN (Calexico2, 11b/g) and Bluetooth Module
WLAN Model Number:	WM3B2200BG
WLAN Manufacturer:	INTEL Corp.
Interface Type:	Mini-PCI Wireless LAN Module
Bluetooth Model Number:	UGXZ5-102A
Bluetooth Manufacturer:	Fujitsu Japan Ltd
FCC ID:	EJE-WB0004
Industry Canada ID:	337J-WB0004
Equipment Type:	Intentional Radiator (Transceiver)
LifeBook PC:	LifeBook S Series
Model Number:	S7010
Codename:	Onion
Manufacturer (LifeBook):	Fujitsu Limited
Address:	1405, Ohamaru, Inagi-shi, Tokyo 206-8503, Japan
Contact:	Mr. Kanbe Katsuhito
Tested for:	Fujitsu Australia Ltd
Address:	5 Lakeside Drive, Burwood East, VIC 3151 Australia
Phone:	+613 9845 4300
Fax:	+613 9845 4600
Contact:	Mr Praveen Rao – Senior Compliance Engineer
Test Standards:	FCC Part 15, Subpart C – Intentional Radiators FCC Part 15.247, 2400 – 2483.5 MHz Operation Band 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 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:	29th January to 13th February 2004
Test Officer:	**Chied 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:	**Chris Zombolas** **Technical Director** **EMC Technologies Pty Ltd**

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

1.0 INTRODUCTION

EMI testing was performed on test sample Mini-PCI Wireless LAN Module (Calexico2, 11b/g), Model WM3B2200BG & ALPS Bluetooth Module, Model UGXZ5-102A.

The Calexico2 module supports IEEE 802.11b and IEEE 802.11g configurations. Tests were performed in both configurations and also on the Bluetooth module. The results for IEEE 802.11b, IEEE 802.11g configurations and the Bluetooth module are reported

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

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

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

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

1.1 Summary of Results

1.1.1 WLAN Module, Calexico2 11b/g

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**
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 Results – Part 1

1.1.2 Bluetooth Module

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)(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 Results – Part 2

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.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample:	Mini-PCI WLAN (Calexico2 11b/g) and Bluetooth Module
WLAN Model Number:	WM3B2200BG
WLAN Manufacturer:	INTEL Corp.
Interface Type:	Mini-PCI Wireless LAN Module
Bluetooth Model Number:	UGXZ5-102A
Bluetooth Manufacturer:	Fujitsu Japan Ltd
FCC ID:	EJE-WB0004
Industry Canada ID:	337J-WB0004
Equipment Type:	Intentional Radiator (Transceiver)
Host PC:	LifeBook S Series
Model Number:	S7010
Code Name:	Onion
Serial Number:	Pre-production Sample
Manufacturer:	Fujitsu Limited
CPU Type and Speed:	Dothan 1.8 GHz Banias 1.7 GHz Celeron-M 1.3 GHz
SDRAM:	248 MB
LCD Screen:	14.1”XGA
Hard Disk Drive:	40 GB
Wired LAN:	Broadcom 10/100 Base-Tx (On Board) Broadcom GbLAN (On Board)
Modem:	MBH7MD33 / MBH7MD35
Wireless LAN (WLAN) Module:	Atheros 11a+b/g (WLL4030) Atheros 11b/g (WLL3050) Calexico2 11b/g (WM3B2200BG)
Port Replicator Model:	FPCPR48 / FPCPR48AP

Bluetooth Module:	ALPS Bluetooth Module
Bluetooth Model Number:	UGXZ5-102A
AC Adapter Model:	SEB80N2-19.0 / SEB100P2-19.0
Alternate Models:	CA01007-093x / CA01007-092x
Voltage:	19 V
Current Specs:	3.16 A (SEB80N2-19.0), 4.22 A (SEB100P2-19.0)
Watts:	60 W (SEB80N2-19.0), 80 W (SEB100P2-19.0)

Additional AC Adapters: Additional Optional AC adapters used with this notebook

Manufacturer	Manufacturer's model name	Fujitsu P/N	Rating
Eastern	UJ97	CA01007-0980	19V-3.16A
Tamura	PTW1931N	CP196212-01	19V-3.16A

2.2 Technical Specifications

2.2.1 WLAN Transmitter Specifications

Transmitter #1:	Mini-PCI Wireless LAN Module
Wireless Module:	Calexico2
Model Number:	WM3B2200BG
Manufacturer:	Intel. Corp.
Modulation Type:	Direct Sequence Spread Spectrum (DSSS for 802.11b) Orthogonal Frequency Division Multiplexing (OFDM for 802.11g)
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 and 802.11g = 54Mbps
Frequency Range:	2.4 –2483.5 GHz for 11b/g
Max. Output Power:	802.11b = 18 dBm 802.11g = 15 dBm
Power Supply:	3.3 VDC from PCI bus
Chipset Used:	Atheros AR5212, AR5112

Frequency allocation for 802.11b/g:

Channel	Frequency (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

2.2.2 Bluetooth Transmitter Specifications

Transmitter#2:

Module:	ALPS Bluetooth Module
Model Number:	UGXZ5-102A
Manufacturer:	Fujitsu Japan 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 Chip Antenna
Max. Output Power:	12dBm
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

2.2 Operational Description

The EUT is a Mini-PCI Wireless LAN (WLAN) Module (WM3B2200BG) and Bluetooth (BT) Module (UGXZ5-102A) for Fujitsu Notebook PCs (Lifebooks). The WLAN module is an OEM product from Intel Corp.,

The intention of this application is to certify the WLAN module and Bluetooth module in the following **Factory-set** Lifebook configurations.

WLAN Module Calexico2, WM3B2200BG				
Antenna Type	**Antenna Gain**	**Host LifeBook Codename**	**Host LifeBook Model Number**	**Radio Configuration**
Mono-pole Ceramic Chip	2.08 dBi max	Onion	S7010	WLAN + BT
		Ginger	S6120/S6120D S6130/S6130D	WLAN +BT
		Onion / Ginger	S7010	WLAN Only
		Onion	S7101	BT Only

The differences in the Host Lifebook models are mainly:
CPU speeds, LCD Screen sizes (14.1" – 13.3") and physical size of the notebooks. The WLAN module, Bluetooth and Antenna are identical and located identically.

According to the manufacturer - any other similar LifeBook models not listed above but using the same WLAN and Antenna configurations shall also be subject to this application.

The measurements reported in this test report are for Onion with Mono-pole Ceramic Chip Antenna representing the various Lifebooks shown in the table above.

2.4 Test Configuration

The INTEL Calexico2 utility 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 softwares.

Antenna
The Calexico2 WLAN (WM3B2200BG) and ALPS Bluetooth device are configured with a Monopole Ceramic Chip antenna, Model YCE-5008. The installation of the OEM WLAN module, Bluetooth Device and the Antenna in Fujitsu LifeBook S Series, Model S7010 (Onion) is in a controlled environment. The installation is performed during the production/assembly process at the Fujitsu factory.

Refer to Appendix N – Antenna Information.

AC Adapter
There are two AC adapter models (SEB80N2-19.0 and SEB100P2-19.0) that were tested with this notebook. Details of the AC adapters are supplied above. The manufacturer has stated that the alternate model numbers (CA1007-093x and CA01007-092x) of these adapters are identical electrically and mechanically**.** The other two optional adapters listed in table above are to be modular approved in this application.

2.5 Block Diagram

Refer to Appendix D - Block Diagram

2.6 Support Equipment

External Monitor/s:	
Conducted EMI	Videocom, Model DCM-1588VAE, FCC ID: H79DCM-1588
Radiated EMI	Hewlett Packard 15" Color monitor, Model D2827A, FCC ID: C5F7NFCMC1515X
Printer:	Diconix, Model: 150 , FCC ID: E759WG-RBCN150
USB Floppy Drives:	Fujitsu Model: FPCFDD11, P/N CP032173-01 Fujitsu Model: FPCFDD12, P/N CP078720-01 USB OMNI Floppy Drive Model # USB F3501 SN W316000096
Headphones:	Verbatim Multimedia Stereo headset
Modem:	Maestro Companion Series 3
PS2 Mouse:	Microsoft Intellimouse, S/N 00723014, FCC ID: C3KKS9
PS2 Keyboard	Logitech, Model: YBA9, S/N MCT94602411
LAN Hub:	Kingston SOHO Hub Model: KNE8TP/H (FCC ID: JICKNE8TP-HO)
PCMCIA Slot:	6 MB Compact flash card with Adapter, Apacer P/N 88.10200030
Secure Digital Slot:	32 MB Secure Digital storage device

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.

RESULTS – PART 1
WLAN Module – Calexico2 (WM3B2200BG)

1.0 CONDUCTED EMISSION MEASUREMENTS

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

1.1 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.

1.2 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.

1.3 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.

1.4 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.

1.5 Results of Conducted Emission Measurements (AC Mains Ports)

Conducted Emission Measurements were performed on the LifeBook S Series, Model S7010 with WLAN module (Calexico2 – 11b/g, WM3B2200BG) and Bluetooth module (UGXZ5-102A). Measurements were tested individually with both adapters (SEB80N2-19.0 and SEB100P2-19.0) and the worst-case measurements results are reported.

Initial investigations were performed with the WLAN in both configurations (802.11b and 802.11g) 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 low (Channel 1, 2412 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 module & Bluetooth module emissions.

Frequency MHz	Line	Measured QP Level dBμV	QP Limit dBμV	ΔQP ±dB	Measured AV Level dBμV	AV Limit dBμV	ΔAV ±dB
0.497	Neutral	45.6	56.0	-10.4	41.3	46.0	-4.7
0.572	Active	43.2	56.0	-12.8	38.7	46.0	-7.3
0.634	Neutral	43.6	56.0	-12.4	37.5	46.0	-8.5
0.354	Neutral	44.5	58.9	-14.4	39.9	48.9	-9.0
0.643	Active	40.6	56.0	-15.4	36.6	46.0	-9.4
0.283	Neutral	46.9	60.7	-13.8	40.0	50.7	-10.7
0.214	Neutral	48.5	63.0	-14.6	40.6	53.0	-12.4
0.215	Active	49.8	63.0	-13.2	40.0	53.0	-13.0
0.573	Neutral	42.8	56.0	-13.2	31.6	46.0	-14.4
0.433	Neutral	42.0	57.2	-15.2	31.5	47.2	-15.7

The worst case conducted EMI occurred at 0.497 MHz (Neutral line) and complied with the FCC quasi peak and average limits by margins of 10.4 dB and 4.7 dB respectively. The measurement uncertainty was ±2.0 dB. Refer to Appendix I Graphs of EMI measurement for plots of the conducted EMI measurements.

Result: Complies

2.0 RADIATED EMISSION MEASUREMENTS

2.1 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 25 GHz.

The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

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

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable, and by varying the antenna height. Each significant peak was investigated with the Quasi-Peak/Average Detectors. The software for cable losses automatically corrected the measurement data for each frequency range, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

2.2 Calculation of field strength

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

E = V + AF - G + L Where:

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

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

2.3 Results - Out of Band Emissions (Spurious and Harmonics)

2.2.1 Frequency Band: 1 – 25 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 Part 2 of this test report.

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2462 MHz), was 37.6 dBμV/m peak (noise floor) 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 35.5 dBμV/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

Measurements for the WLAN were made on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

2.3.1.1 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).

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	59.6	46.4	Vert/Hort	74.0	54.0	Pass
7236	70.3	52.7	Vert/Hort	-	-	Pass
9648	61.8	47.8	Vert/Hort	-	-	Pass
12060	53.5	42.3	Vert/Hort	74.0	54.0	Pass
14472	54.2	42.6	Vert/Hort	74.0	54.0	Pass
16884	54.9	42.2	Vert/Hort	-	-	Pass
19296	57.3	44.1	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	69.9	45.9	Vert/Hort	-	-	Pass
24120	60.8	47.7	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	57.7	44.5	Vert/Hort	74.0	54.0	Pass
7311	68.7	49.6	Vert/Hort	74.0	54.0	Pass
9748	58.2	45.8	Vert/Hort	-	-	Pass
12185	50.1	39.9	Vert/Hort	74.0	54.0	Pass
14622	54.5	42.1	Vert/Hort	-	-	Pass
17059	54.8	42.3	Vert/Hort	-	-	Pass
19496	57.0	44.4	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	68.8	45.8	Vert/Hort	-	-	Pass
24370	60.3	47.7	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	55.4	42.7	Vert/Hort	74.0	54.0	Pass
7386	66.1	47.8	Vert/Hort	74.0	54.0	Pass
9848	55.9	43.3	Vert/Hort	-	-	Pass
12310	47.7	36.1	Vert/Hort	74.0	54.0	Pass
14772	53.2	42.0	Vert/Hort	-	-	Pass
17234	55.0	42.6	Vert/Hort	-	-	Pass
19696	57.4	44.8	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	68.6	45.7	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	60.3	48.5	Vert/Hort	-	-	Pass

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

Harmonics were recorded within the restricted bands of up to 25 GHz and complied with the FCC Class B average limits by a margin of 4.4 dB. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

Result: Complies

2.3.1.2 Configuration 802.11g

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).

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	45.6	34.8	Vert/Hort	74.0	54.0	Pass
7236	57.1	43.3	Vert/Hort	-	-	Pass
9648	46.8	35.0	Vert/Hort	-	-	Pass
12060	51.2	38.9	Vert/Hort	74.0	54.0	Pass
14472	53.1	41.4	Vert/Hort	74.0	54.0	Pass
16884	54.9	42.7	Vert/Hort	-	-	Pass
19296	56.4	44.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21708	58.0	46.1	Vert/Hort	-	-	Pass
24120	59.9	47.3	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	44.3	33.6	Vert/Hort	74.0	54.0	Pass
7311	54.5	42.1	Vert/Hort	74.0	54.0	Pass
9748	45.7	34.5	Vert/Hort	-	-	Pass
12185	50.4	38.9	Vert/Hort	74.0	54.0	Pass
14622	52.8	41.0	Vert/Hort	-	-	Pass
17059	54.1	42.3	Vert/Hort	-	-	Pass
19496	56.4	44.5	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21933	58.2	46.2	Vert/Hort	-	-	Pass
24370	60.3	47.7	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	42.9	32.0	Vert/Hort	74.0	54.0	Pass
7386	52.4	40.7	Vert/Hort	74.0	54.0	Pass
9848	44.3	34.1	Vert/Hort	-	-	Pass
12310	50.0	38.8	Vert/Hort	74.0	54.0	Pass
14772	52.6	41.1	Vert/Hort	-	-	Pass
17234	54.1	42.4	Vert/Hort	-	-	Pass
19696	56.5	44.7	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22158	57.8	46.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24620	60.1	47.6	Vert/Hort	-	-	Pass

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

Harmonics were recorded within the restricted bands of up to 25 GHz and complied with the FCC Class B average limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

Result: Complies

2.3.2 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 10 metres.

Measurements were tested individually with both adapters (SEB80N2-19.0 and SEB100P2-19.0) and it was found that the results were not significantly different.

Initial investigations were performed with the WLAN in both configurations (802.11b and 802.11g) 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 module & Bluetooth module emissions.

LIFEBOOK S Series, Model S7010D (Onion) - WLAN Module (Calexico2 – 11b/g, WM3B2200BG) & Bluetooth Module, UGXZ5-102A

Vertical Polarity

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
400.26	Vertical	29.6	36.0	-6.4
601.33	Vertical	27.2	36.0	-8.8
99.50	Vertical	22.7	33.5	-10.8
282.08	Vertical	24.8	36.0	-11.2
365.88	Vertical	24.0	36.0	-12.0
100.00	Vertical	21.4	33.5	-12.2
66.32	Vertical	17.3	30.0	-12.8
159.50	Vertical	19.4	33.5	-14.1
122.89	Vertical	19.1	33.5	-14.4
45.33	Vertical	11.7	30.0	-18.3
400.26	Vertical	29.6	36.0	-6.4
601.33	Vertical	27.2	36.0	-8.8
99.50	Vertical	22.7	33.5	-10.8
282.08	Vertical	24.8	36.0	-11.2
365.88	Vertical	24.0	36.0	-12.0

Horizontal Polarity

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
400.20	Horizontal	34.6	36.0	-1.4
500.30	Horizontal	29.6	36.0	-6.4
369.94	Horizontal	23.1	36.0	-12.9
111.72	Horizontal	15.3	33.5	-18.2
120.35	Horizontal	14.0	33.5	-19.5

The highest radiated emission peak occurred at 400.20 (horizontal polarity) and complied with FCC quasi peak limit by a margin of 1.4 dB. The measurement uncertainty in this band was ± 3.7 dB. Refer to tables above for results.

Result: Complies.

2.3.3 Band Edge Measurements

The highest emission level that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the operating band.

Testing was performed while the WLAN transmitter continuously transmitted on a low (2412 MHz) and high frequency (2462 MHz) channel.

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

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

2.3.3.1 Calexico2 (WM3B2200BG) - Configuration 802.11b

Refer to Appendix K1 for Band Edge plots
NB: D1 line indicates the highest level of the transmitter
D2 line indicates 20 dB limit below D1.

2.3.3.2 Calexico2 (WM3B2200BG) - Configuration 802.11g

Refer to Appendix K2 for Band Edge plots
NB: D1 line indicates the highest level of the transmitter
D2 line indicates 20 dB limit below D1.

Result: Complies.

3.0 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 resolution bandwidth of 10 MHz and the video bandwidth of 10 MHz were utilised.

The Peak Output Power (P) was calculated as follows:

P = R + G + C where R is the recorded peak power
G is the antenna gain in dBi &
C is the cable loss

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

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.

3.1 Configuration 802.11b

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

The resolution bandwidth of 20 MHz and the video bandwidth of 20 MHz were utilised.

Frequency MHz	R dBm	Coax Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
2412	20.5	- 0.5	2.08	22.1	30	162.2	1000
2437	20.0	- 0.5	2.08	21.6	30	144.5	1000
2462	19.8	- 0.5	2.08	21.4	30	138.0	1000

The specification limit is 1W (30 dBm).

Result: Complies.

3.2 Configuration 802.11g

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).

The resolution bandwidth of 20 MHz and the video bandwidth of 20 MHz were utilised.

Frequency MHz	R dBm	Coax Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
2412	21.6	- 0.5	2.08	23.2	30	208.9	1000
2437	21.3	- 0.5	2.08	22.9	30	195.0	1000
2462	21.2	- 0.5	2.08	22.8	30	190.5	1000

The specification limit is 1W (30 dBm).

Result: Complies

4.0 CHANNEL BANDWIDTH

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

In the band 2400 - 2483.5 MHz the minimum 6 dB bandwidth was at least 500 kHz. The 6 dB bandwidth was measured while the transmitter continuously transmitted on a low, middle and high frequency channel.

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

Measurements were made on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

4.1 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	10.02	Complies	Appendix J1
2437.0	10.06	Complies	Appendix J1
2462.0	9.99	Complies	Appendix J1

The minimum 6 dB bandwidth is at least 500 kHz

Result: Complies

4.2 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	16.47	Complies	Appendix J2
2437.0	16.43	Complies	Appendix J2
2462.0	16.51	Complies	Appendix J2

The minimum 6 dB bandwidth is at least 500 kHz

Result: Complies

5.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

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

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

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 normally cannot 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.

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 Part 1, section 3.0 of this report. (WLAN Module):
Maximum peak output power at the antenna terminal = 21.6dBm = 144.5mW
Antenna (Monopole Ceramic Chip) gain (typical) = 2.08 dBi = 1.614 numeric
Prediction distance = 20 cm
Prediction frequency = 2412 MHz
MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm^2

Therefore, the power density at prediction frequency (Pd) = 0.0464 mW/cm^2

The result was extracted from Part 2, section 3.0 of this report. (Bluetooth Module):
Maximum peak output power at the antenna terminal = 11.59dBm = 14.4mW
Antenna (Monopole Ceramic Chip) gain (typical) = 2.08 dBi = 1.614 numeric
Prediction distance = 20 cm
Prediction frequency = 2402 MHz
MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm^2

Therefore, the power density at prediction frequency (Pd) = 0.0046mW/cm^2

The total power density (TPd) for WLAN and Bluetooth transmitters continuously operated:

TPd = 0.0464 (WLAN) + 0.0046 (Bluetooth) = 0.051mW/cm^2

Results: Complies

6.0 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

Testing was performed while the transmitter continuously transmitted on a low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) frequency channel.

6.1 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	- 9.68	8.0	Complies	Appendix L1
2437.0	- 10.94	8.0	Complies	Appendix L1
2462.0	- 12.06	8.0	Complies	Appendix L1

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

Result: Complies

6.2 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	- 16.88	8.0	Complies	Appendix L2
2437.0	- 17.81	8.0	Complies	Appendix L2
2462.0	- 17.75	8.0	Complies	Appendix L2

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

Result: Complies

7. 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.

8.0 COMPLIANCE STATEMENT

The Mini-PCI Wireless LAN (WLAN) Module, Model WM3B2200BG (Calexico2 11b/g) and Bluetooth Module, 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.

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

Results were as follows:

WLAN Module, Calexico2 11b/g

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**
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**

Bluetooth Module

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)(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 Results – Part 2

RESULTS – PART 2
Bluetooth Module, Model UGXZ5-102A

1.0 CONDUCTED EMISSION MEASUREMENTS

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

1.1 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.

1.2 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.

1.3 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.

1.4 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.

1.5 Results of Conducted Emission Measurements (AC Mains Ports)

Refer to Results Part 1, Section 1.5.

2.0 RADIATED EMISSION MEASUREMENTS

2.1 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 25 GHz.

The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

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

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable, and by varying the antenna height. Each significant peak was investigated with the Quasi-Peak/Average Detectors. The software for cable losses automatically corrected the measurement data for each frequency range, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

2.2 Calculation of field strength

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

E = V + AF - G + L Where:

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

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

2.3 Results - Out of Band Emissions (Spurious and Harmonics)

2.3.1 Frequency Band: 1 – 25 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 Bluetooth transmitter are reported below. For harmonics related to the WLAN transmitter, Refer to Part 1 of this test report (802.11b/g).

The field strength at 2483.5 MHz when the EUT was operating at its highest channel (2480 MHz), was 38.1 dBμV/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

The field strength at 2400 MHz when the EUT was operating at its lowest channel (2402 MHz), was 35.5 dBμV/m peak (noise floor) and was > 20 dB below the maximum field strength of the in-band carrier.

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

Channel 1 - 2402 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2402	Transmitter	Fundamental		-	-	
4804	46.2	35.0	Vert/Hort	74.0	54.0	Pass
7206	49.0	38.5	Vert/Hort	-	-	Pass
9608	43.4	33.6	Vert/Hort	-	-	Pass
12010	48.8	36.9	Vert/Hort	74.0	54.0	Pass
14412	50.3	38.4	Vert/Hort	-	-	Pass
16814	52.7	41.2	Vert/Hort	-	-	Pass
19216	54.6	43.0	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21618	56.9	44.7	Vert/Hort	-	-	Pass
24020	59.0	46.9	Vert/Hort	-	-	Pass

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

Channel 40 - 2441 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2441	Transmitter	Fundamental		-	-	
4882	47.0	35.3	Vert/Hort	74.0	54.0	Pass
7323	50.8	39.8	Vert/Hort	74.0	54.0	Pass
9764	43.9	33.4	Vert/Hort	-	-	Pass
12205	48.5	37.5	Vert/Hort	74.0	54.0	Pass
14646	51.1	39.0	Vert/Hort	-	-	Pass
17087	52.7	41.3	Vert/Hort	-	-	Pass
19528	55.6	43.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
21969	57.3	45.9	Vert/Hort	-	-	Pass
24410	60.2	47.7	Vert/Hort	-	-	Pass

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

Channel 79 - 2480 MHz

Frequency MHz	Level dBuV/m		Antenna Polarization	Peak Limit dBuV/m	Average Limit dBuV/m	Result
	Peak Detector	Average Detector				
2480	Transmitter	Fundamental		-	-	
4960	48.2	36.9	Vert/Hort	74.0	54.0	Pass
7440	53.7	42.7	Vert/Hort	74.0	54.0	Pass
9920	44.9	34.0	Vert/Hort	-	-	Pass
12400	49.6	38.5	Vert/Hort	74.0	54.0	Pass
14880	51.6	39.1	Vert/Hort	-	-	Pass
17360	53.3	41.9	Vert/Hort	-	-	Pass
19840	55.8	43.2	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
22320	57.0	45.4	Vert/Hort	84.0* (1m)	64.0* (1m)	Pass
24800	59.5	46.7	Vert/Hort	-	-	Pass

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

Harmonics were recorded within the restricted bands of up to 25 GHz and complied with the FCC Class B average limits by a margin of greater than 10 dB. Harmonics were below the limit in section 15.209. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

Result: Complies

2.3.2 Frequency Band: 30 - 1000 MHz

Refer to Results Part 1, Section 2.3.2

2.3.3 Band Edge Measurements

The highest emission level that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the operating band.

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

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

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

Refer to Appendix K3 for Band Edge plots
NB: D1 line indicates the highest level of the transmitter
D2 line indicates 20 dB limit below D1.

Result: Complies.

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

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

Measurements were performed while the Bluetooth transmitter continuously transmitted.

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

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

The Peak Output Power (P) was calculated as follows:

P = R + G + C where R is the recorded peak power
G is the antenna gain in dBi &
C is the cable loss

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

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

Frequency MHz	R dBm	Coax Loss dB	G dBi	P dBm	Limit dBm	P mW	Limit mW
2402.0	11.59	- 0.5	2.08	13.17	30	20.7	1000
2441.0	11.35	- 0.5	2.08	12.93	30	19.6	1000
2480.0	11.35	- 0.5	2.08	12.93	30	19.6	1000

The specification limit is 1W (30 dBm).

Result: Complies.

4.0 CHANNEL BANDWIDTH & CHANNEL OCCUPANCY

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

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

4.1 Channel Bandwidth

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

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

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

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

Frequency MHz	Bandwidth kHz	Result	20 dB Bandwidth Plots
2402	739	Complies	Appendix J3
2441	733	Complies	Appendix J3
2480	745	Complies	Appendix J3

4.2 Channel Occupancy

This measurement was made on a channel using a spectrum analyser with a 0 Hz span and a sweep time of 5 mS.

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

The channel separation of 1 MHz was recorded.

The device was observed to have a dwell time of 420.8 uS. Refer to Appendix M for dwell time plot.

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

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

During the test the transmitter was observed to activate on average 325 times in 31.6 seconds.

The transmitter therefore occupies in one channel for 325 x 420.8uS = 0.137 seconds

Result: Complies.

5.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

Refer to Results Part 1, Section 5.0

6. 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.

7.0 COMPLIANCE STATEMENT

The Mini-PCI Wireless LAN (WLAN) Module, Model WM3B2200BG (Calexico2 11b/g) and Bluetooth Module, 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.

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

Results were as follows:

Bluetooth Module

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)(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**

WLAN Module, Calexico2 11b/g

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**
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 Results – Part 1

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 8574B System Components	12/02/03	12/02/04	1 YEAR *2
EMI RECEIVER	Rohde & Schwarz, Model ESIB40 SN 1088 7490, 20 Hz – 40 GHz	09/07/03	09/07/04	1 YEAR *3
EMI RECEIVER	Rohde & Schwarz, Model FSET22 SN 1080 3508, 100 Hz – 22 GHz	31/10/03	31/10/04	1 YEAR *3
RF PRE-SELECTOR	Rohde & Schwarz, Model FSET-Z22 SN 1070 2009, 100 Hz – 22 GHz	31/10/03	31/10/04	1 YEAR *3
ANTENNAS	EMCO 93110B BICONICAL	20/08/03	20/08/04	1 YEAR *1
	20 - 300 MHz Sn. 9804-3092			
	EMCO 93146A LOG PERIODIC	11/07/03	11/07/04	1 YEAR *1
	200 -1000MHz Sn. 5033			
	EMCO 3115 DOUBLE RIDGED HORN 1 - 18 GHz Sn: 8908-3282	29/01/03	29/01/04	1 YEAR *1
	EMCO 3116 Double Ridged Guide Horn	--------	--------	*4
	18 – 40 GHz Sn 2276			
LISN	EMCO 3825/2 50ohm / 50 microH	10/02/03	10/02/04	1 YEAR *1
	0.009 – 30MHz Sn.9607-2567			

Note *1. In-house calibration. Refer to Quality Manual.
Note *2. NATA calibration by Agilent Technologies (Aust) Pty Ltd
Note *3. NATA calibration by Rohde & Schwarz
Note *4. Manufacturer's calibration

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

APPENDIX A: MEASUREMENT INSTRUMENT DETAILS
APPENDIX B: REPORT PHOTOGRAPHS
APPENDIX C: FUNCTIONAL DESCRIPTION
APPENDIX D: BLOCK DIAGRAM
APPENDIX E: SCHEMATICS
APPENDIX F: PCB LAYOUTS
APPENDIX G: SPECIFICATIONS
APPENDIX H: FCC LABELLING DETAILS
APPENDIX I: GRAPHS of EMI MEASUREMENTS
APPENDIX J: CHANNEL BANDWIDTH PLOTS
APPENDIX K: BANDEDGE PLOTS
APPENDIX L: PEAK POWER SPECTRAL DENSITY PLOTS
APPENDIX M: BLUETOOTH CHANNEL OCCUPANCY PLOTS
APPENDIX N: ANTENNA INFORMATION (MONOPOLE CERAMIC CHIP ANTENNA)
APPENDIX O: USER MANUAL