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

FCC ID:	UWT-RX-4002-02
Test Sample:	Intelligent Network Node (RX INN)
Model:	RX-4002
Radio Module:	IEEE 802.11a/b/g Wireless Mini-PCI Adapter
Model:	NMP-8602 PLUS
Report Number:	M061023_Cert_RX-INN_Class_2
Tested for:	aCure Technology Pty Ltd
Issue Date:	18th March 2007

NATA Accredited Laboratory Number: 5292

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Radio Module:	IEEE 802.11a/b/g Wireless Mini-PCI Adapter
Model:	NMP-8602 PLUS
FCC ID:	UWT-RX-4002-02
Equipment Type:	Intentional Radiator
Tested For:	aCure Technology Pty Ltd
Address:	78 Hasler Road Osborne Park WA 6015 Australia
Contact:	Mark Middleton
Test Standards:	FCC Part 15 – Radio Frequency Devices (August 2006) FCC Part 15 Subpart C - Intentional Radiators Section 15.247: 2400 – 2483.5 MHz & 5725 – 5850 MHz Operation Bands ANSI C63.4 – 2003 OET Bulletin No. 65
Test Dates:	23rd October 2006 to 27th February 2007
Test Engineers:	**Chieu Huynh - B.Eng (Hons) Electronics** **Kevin Hansen**
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**

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1.0 INTRODUCTION

EMI testing was performed on the Intelligent Network Node, Model: RX-4002 with IEEE 802.11a/b/g Wireless Mini-PCI Adapter, Model: NMP-8602 PLUS.

The Wireless module was originally certified by SENAO INTERNATIONAL CO., LTD under FCC ID: NI3-MP86005001. The intention of this application is to re-certify the wireless module installed in the Intelligent Network Node, Model: RX-4002 with a higher antenna gain as a **Class II Permissive Change.**

The Wireless module supports IEEE 802.11b, IEEE 802.11g and IEEE802.11a configurations. Tests were performed in all three configurations and the results are reported in this test report.

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

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

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

The measurement procedure used was in accordance with ANSI C63.4-2003 and OET Bulletin No. 65. The instrumentation conformed to the requirements of ANSI C63.2-1996.

1.1 Summary of Results - FCC Subpart C, Section 15.247

FCC Part 15 Subpart C, Clauses	Test Performed	Results
15.203	Antenna Requirement	**Complies**
15.205	Operation in Restricted Band	**Complies**
15.207	Conducted Emissions	**Complies**
15.209	Radiated Emissions	**Complies**
15.247 (a)(2)	Channel Bandwidth	**Complies**
15.247 (b)	Peak Output Power	**Not applicable. Refer to 15.247 (c)** Antenna Gain > 6 dBi.
15.247 (c)	Antenna Gain > 6 dBi	**Yes, complies**
15.247 (d)	Out of Band Emissions	**Complies**
15.247 (e)	Peak Power Spectral Density	**Complies**
15.247 (f)	*Hybrid Systems	**Not Applicable** EUT does not employ a hybrid system
15.247 (g)	Frequency Hopping	**Not Applicable** EUT does not employ a frequency hopping modulation technique
15.247 (h)	Frequency Hopping	**Not Applicable** EUT does not employ a frequency hopping modulation technique
15.247 (i)	Radio Frequency Hazard	**Complies**

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

1.2 Modifications by EMC Technologies

No modifications were required.

2.0 EUT DETAILS

(Information supplied by the Client)

2.1 General

The Intelligent Network Node, Model: RX-4002 with IEEE 802.11a/b/g Wireless Mini-PCI Adapter, Model: NMP-8602 PLUS.

The aCure Technology Intelligent Network Node (INN) model RX-4002 is a four radio dual band node operating as an 802.11 a/b/g access point that is designed for the deployment of metropolitan wireless networks operating in the frequency range 2.400-2.4835 GHz and 5.725-5850 GHz.

It's typical deployment is for outside use as a wall or pole mounted unit with antenna's being externally connected to the EUT through four N-type connectors located at the base of the unit. The external antenna's are then placed typically up to 10 meters from the EUT but providing a minimum separation between antennas.

The INN RX-4002 employs as per 802.11-DBPSK, DQPSK, CCK, OFDM modulation modes of operation.

Frequency Range
2.400-2.4835 GHz (Channels 1 – 11)
5.725-5850 GHz (Channels 149 – 165)

Equipment Models
Tested was the INN model 4002 which comprises:
1 x INN RX-4002
1 x PoE Injector
1 x 48VDC 100/240VAC Power Supply

EUT Adaptor Details
Hyperlink Technologies Inc. Switching Power Supply
Model No. PSU40B-8
Input Supply: 100-240V AC, 50/60 Hz, 1.0A
Output Supply: 48V DC, 0.83A, 40 watts max.

Antenna Details
The RX INN 4002 was tested with:
Stub Loaded Helix Antenna (SLH12) 2.4 GHz @ 12 dBi
Panel Antenna (PAN22) 5.7 GHz @ 22 dBi

I/O Ports
The EUT has the following I/O ports located at it's base:
4 x N-type connectors for antenna connections
3 x Waterproof RJ45 connectors with two being used for Ethernet connectivity and one being used as an RS232 console connection.
1 x Waterproof 8 pin connector for the installation of an external power supply.
The electrical rating of the EUT is 48 VDC and typically power is provided through Power over Ethernet with a shielded PoE injector and 48VDC power supply forming part of the solution.

The system is a point-to-multipoint system by it's general nature of being an Access Point. Typically use:

802.11b/g: For client connectivity. That is a single SLH antenna servicing multiple clients in a typical access point fashion.

802.11a: For backhaul connectivity. Normally install these in a point to point set-up to provide backhaul for the network. It is possible that backhaul is also run in a point to multipoint configuration but in a fixed model. That is we support multiple of our radios connecting back to a single radio for the purposes of backhaul but only accepting connection from our equipment.

2.2 Operational Description

RoamAD software was used to configure the wireless to transmit continuously during the tests.

2.3 Test Configuration

Conducted tests were performed at the WLAN Antenna ports.
Radiated tests were performed for measuring the harmonics and spurious from the transmitters.

The EUT is a four identical radio modules, therefore testing were performed on a single radio module, except co-location testing were performed with all four radio modules transmitting.

2.4 Support Equipment

A Dell PC (Model PP08L) was used to run the RoamAD software.

2.5 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-2003. Radiated emissions tests were performed at a distance of 1 and 3 metres from the EUT. OET Bulletin 65 dated June 2001 was used for reference.

2.6 Test Facility

2.6.1 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 measurements at an antenna ports were performed at EMC Technologies' laboratory in Tullamarine, Victoria Australia.

The above test sites have been accepted for testing by the Federal Communications Commission (FCC) - **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.

2.6.2 NATA Accreditation

EMC Technologies is accredited in Australia to test to the following standards by the National Association of Testing Authorities (NATA).

"FCC Part 15 unintentional and intentional emitters in the frequency range 9kHz to 18 GHz excluding TV receivers (15.117 and 15.119), TV interface devices (15.115), cable ready consumer electronic equipment (15.118), cable locating equipment (15.213) and unlicensed national information infrastructure devices (Sub part E)."

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

NATA is the Australian national laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A^2LA).

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

2.8 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

3.0 CONDUCTED EMISSION MEASUREMENTS

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

3.1 Test Procedure

The arrangement specified in ANSI C63.4-2003 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2-1996 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured.

3.2 Peak Maximising Procedure

The various operating modes of the system were investigated. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

3.3 Calculation of Voltage Levels

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

VEMI = **VRx + LBPF**

Where: **VEMI =** the Measured EMI voltage in dBµV to be compared to the limit.
VRx = the Voltage in dBµV read directly at the EMI receiver.
LBPF = the loss in dB of the cables and the Limiter and Band pass Filter.

3.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were then concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph were subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

3.5 Results of Conducted Emission Measurements (AC Mains Ports)

Initial investigations were performed with all modulation types. No significant differences in emissions were observed. Final testing was performed while the WLAN transmitter continuously operated on the low (Channel 1, 2412 MHz) frequency channel with the modulation rate of 11 Mbps (CCK).

The worst case emissions complied with the quasi peak and average limits by margins of 10.6 dB and 1.6 dB respectively. The measurement uncertainty was ±2.0 dB. Refer to Appendix F (graphs 1 & 2) for plots of the conducted EMI measurements.

4.0 SPURIOUS EMISSION MEASUREMENTS

4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.247(d) and FCC Part 15.209.

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

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

The measurement of emissions above 1000 MHz was measured using a following setting:
Peak measurements setting: RBW = VBW = 1 MHz
Average measurements setting: RBW = 1 MHz and VBW = 10 Hz

The receiver bandwidth was set to 6 dB.

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

4.2 Calculation of field strength

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

E = V + AF - G + L Where:

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

- **Example Field Strength Calculation**

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

34.0 + 9.2 + 1.9 - 20 = 25.1 dBμV/m

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (1000 MHz – 18,000 MHz) ± 4.1 dB
(30 MHz – 1,000 MHz) ± 3.7 dB

4.3 Radiated Emissions (Spurious and Harmonics)

4.3.1 Frequency Band: 1 – 40 GHz

All measurements above 1 GHz were initially made over a distance of 3 metres. This was decreased to 1.0 metre as the emission levels from the device were very low.

The 74 dBμV/m @ 3m and 54 dBμV/m @ 3m limits are applied for emissions fall in the restricted bands.

802.11b/g testing was performed using a Stub Loaded Helix Antenna (SLH12) with 12 dBi.
802.11a testing was performed using a Panel Antenna (PAN22) with 22 dBi

4.3.1.1 Configuration 802.11b

Initial investigations were performed with three modulation types: (DBPSK, DQPSK and CCK). Peak measurements were performed with 11 Mbps (CCK) and average measurements were performed with 1 Mbps (DBPSK).

Channel 1 - 2412 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2412	120.3	74.3	-	-	-
4824	67.3	50.0	74.0	54.0	Pass
7236	68.4	48.1	-	-	-
9648	58.9	45.6	-	-	-
12060	55.2	42.4	74.0	54.0	Pass
14472	63.2	52.1	74.0	54.0	Pass
3216.1	55.5	53.3	-	-	-

Channel 6 - 2437 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2437	121.0	74.2	-	-	-
4874	67.0	49.8	74.0	54.0	Pass
7311	67.7	47.3	74.0	54.0	Pass
9748	58.8	44.7	-	-	-
12185	55.2	42.0	74.0	54.0	Pass
14622	62.1	50.6	-	-	-
3249	55.8	53.8	-	-	-

Channel 11 - 2462 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2462	119.4	74.0	-	-	-
4924	65.2	49.1	74.0	54.0	Pass
7386	66.5	46.0	74.0	54.0	Pass
9848	62.1	46.7	-	-	-
12310	55.0	42.1	74.0	54.0	Pass
14772	61.8	50.9	-	-	-
3282.7	55.4	53.5	-	-	-

Result: Harmonic and spurious emissions were recorded within the restricted bands of up to 25 GHz. Other harmonics and spurious emissions were confirmed low with both RBW and VBW reduced. The worst case emissions complied with the FCC limits of sections 15.209 and 15.247 by a margin of 1.3 dB. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.1.2 Configuration 802.11g

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). No significant 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	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2412	117.2	52.8	-	-	-
4824	63.5	37.3	74.0	54.0	Pass
7236	64.7	37.1	-	-	-
12060	60.5	39.9	74.0	54.0	Pass
3216	54.9	52.5	-	-	-

Channel 6 - 2437 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2437	116.7	53.9	-	-	-
4874	65.8	38.3	74.0	54.0	Pass
7311	66.2	38.5	74.0	54.0	Pass
12185	60.4	40.1	74.0	54.0	Pass
3249.3	55.6	53.0	-	-	-

Channel 11 - 2462 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2462	116.0	52.8	-	-	-
4924	65.5	38.0	74.0	54.0	Pass
7386	68.9	39.7	74.0	54.0	Pass
12310	61.1	40.5	74.0	54.0	Pass
3282.6	56.2	53.3	-	-	-

Result: Harmonic and spurious emissions were recorded within the restricted bands of up to 25 GHz. Other harmonics and spurious emissions were confirmed low with both RBW and VBW reduced. The worst case emissions complied with the FCC limits of sections 15.209 and 15.247 by a margin of 5.1 dB. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.1.3 Configuration 802.11a

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

Channel 149 - 5745 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
5745	119.3	52.8	-	-	-
11490	71.7	39.7	74.0	54.0	Pass
3830	52.7	50.2	74.0	54.0	Pass

Channel 157 - 5785 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
5785	120.8	53.5	-	-	-
11570	73.4	40.3	74.0	54.0	Pass
3856	54.6	52.1	74.0	54.0	Pass

Channel 165 - 5825 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
5825	120.0	53.2	-	-	-
11650	73.3	41.0	74.0	54.0	Pass
3883	54.0	52.2	74.0	54.0	Pass

Result: Harmonic and spurious emissions were recorded within the restricted bands of up to 40 GHz. Other harmonics and spurious emissions were confirmed low with both RBW and VBW reduced. Emissions complied with the FCC limits of section 15.209 and 15.247 by a margin of 0.6 dB. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.2 Frequency Band: 30 - 1000 MHz

Testing was performed at a distance of 3 metres.

Initial investigations were performed with all modulation types. No significant differences in emissions were observed. Final testing was performed while the WLAN transmitter continuously operated on the low (Channel 1, 2412 MHz) frequency channel with the modulation rate of 11 Mbps (CCK).

Frequency MHz	Polarisation	QP Measured dBμV/m	QP Limit dBμV/m	ΔQP ± dB
165.05	Horizontal	43.3	43.5	-0.2
165.78	Horizontal	43.1	43.5	-0.4
200.00	Horizontal	42.6	43.5	-0.9
206.55	Vertical	42.3	43.5	-1.2
762.54	Horizontal	44.8	46.0	-1.2
762.55	Vertical	44.5	46.0	-1.5
895.15	Vertical	44.0	46.0	-2.0
696.23	Vertical	43.9	46.0	-2.1
205.83	Vertical	41.2	43.5	-2.3
205.61	Vertical	40.8	43.5	-2.7
202.38	Horizontal	40.7	43.5	-2.8
828.87	Horizontal	42.9	46.0	-3.1
207.49	Vertical	40.2	43.5	-3.3
204.60	Horizontal	40.0	43.5	-3.5
232.12	Horizontal	41.9	46.0	-4.1
696.25	Horizontal	41.8	46.0	-4.2
165.78	Vertical	39.3	43.5	-4.2
166.64	Vertical	38.5	43.5	-5.0

Results: The highest radiated emission peak occurred at 165.05 MHz and complied with FCC quasi peak limit by a margin of 0.2 dB. The measurement uncertainty in this band was ± 3.7 dB. Refer to Appendix F (graphs 3 & 4) for plots of the radiated EMI measurements.

4.3.3 Co-location Results (All four transmitters transmitting)

Result: IM spurious emissions were recorded up to 40 GHz. Emissions complied with the FCC limits of section 15.209 and 15.247. The measurement uncertainty for radiated emissions in this band was ±4.1 dB.

4.3.4 RF Conducted Measurements at the Antenna Terminal

In the 100 kHz bandwidth within the operating band, the highest emissions (spurious/harmonics) level that is produced by the intentional radiator shall be at least 20 dB below.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised.

D1 line indicates the 20 dB limit below the highest level of the transmitter

Configuration 802.11a
Refer to Appendix H1 for Harmonics plots

Configuration 802.11b
Refer to Appendix H2 for Harmonics plots

Configuration 802.11g
Refer to Appendix H3 for Harmonics plots

Results: Complies.

4.3.5 Band Edge Measurements

In the 100 kHz bandwidth within the operating band, the highest emissions (spurious/harmonics) level that is produced by the intentional radiator shall be at least 20 dB below.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised.

Configuration 802.11a
Refer to Appendix I1 for Band Edge plots

Configuration 802.11b

BE Frequency (MHz) within the restricted band	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2390	73.7	low	74.0	54.0	Pass
2483.5	68.0	low	74.0	54.0	Pass

Refer to Appendix I2 for Band Edge plots

Configuration 802.11g

BE Frequency (MHz) within the restricted band	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2390	71.7	low	74.0	54.0	Pass
2483.5	67.4	low	74.0	54.0	Pass

Refer to Appendix I3 for Band Edge plots

Results: Complies.

5.0 PEAK OUTPUT POWER

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

Measurements were performed while the WLAN transmitter continuously transmitted.

The peak output power measurement was performed using the integration method as per test method # 3 of DA 02-2138. The resolution bandwidth of 1 MHz was used. The video bandwidth of 50 kHz was used for 802.11a and 802.11g (VBW ≥ 1/T, where T (worst case) = 26 μS. The video bandwidth of 10 kHz was used for 802.11b (VBW ≥ 1/T, where T (worst case) = 260 μS.

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

5.1 Configuration 802.11a

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Power with BPSK modulation was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 6 Mbps (BPSK)

Filing	Frequency MHz	Antenna Gain (dBi)	Measured dBm	Limit dBm	Measured mW	Limit mW	Result
*C2PC	5745	22.0	10.9	30.0	12.3	1000	Complies
	5785	22.0	12.1	30.0	16.2	1000	Complies
	5825	22.0	12.4	30.0	17.4	1000	Complies
Original Grant (Senao)		1.5	22.7	30	186.2	1000	Complies

*The transmitter has an antenna gain of greater than 6 dBi. No reduction in transmitter output power is required in according to paragraph 15.247 (c)(1)(ii)

5.2 Configuration 802.11b

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

Filing	Frequency MHz	Antenna Gain (dBi)	Measured dBm	Limit dBm	Measured mW	Limit mW	Result
*C2PC	2412	12	22.5	28.0	177.8	631	Complies
	2437	12	22.3	28.0	169.8	631	Complies
	2462	12	22.0	28.0	158.5	631	Complies
Original Grant (Senao)		2	25.26	30	335.7	1000	Complies

*The transmitter has an antenna gain of greater than 6 dBi and therefore the limit is corrected according to paragraph 15.247(c)(1)(i)

5.3 Configuration 802.11g

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Power with BPSK modulation was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 6 Mbps (BPSK)

Filing	Frequency MHz	Antenna Gain (dBi)	Measured dBm	Limit dBm	Measured mW	Limit mW	Result
*C2PC	2412	12	15.1	28.0	32.4	631	Complies
	2437	12	15.2	28.0	33.1	631	Complies
	2462	12	15.5	28.0	35.5	631	Complies
Original Grant (Senao)		2	26.26	30	422.7	1000	Complies

*The transmitter has an antenna gain of greater than 6 dBi and therefore the limit is corrected according to paragraph 15.247(c)(1)(i)

6.0 CHANNEL BANDWIDTH

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

In the bands 2400 - 2483.5 MHz and 5725 - 5850 MHz, the minimum 6 dB bandwidth was at least 500 kHz. The 6 dB bandwidth was measured while the transmitter continuously transmitted.

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

The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised

The minimum 6 dB bandwidth is at least 500 kHz

6.1 Configuration 802.11a

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

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
5745	16.5	Complies	Appendix G1
5785	16.4	Complies	Appendix G1
5825	16.4	Complies	Appendix G1

6.2 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	11.6	Complies	Appendix G2
2437.0	11.7	Complies	Appendix G2
2462.0	11.8	Complies	Appendix G2

6.3 Configuration 802.11g

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

Frequency MHz	Bandwidth MHz	Result	6 dB Bandwidth Plots
2412.0	16.5	Complies	Appendix G3
2437.0	16.6	Complies	Appendix G3
2462.0	16.6	Complies	Appendix G3

7.0 PEAK POWER SPECTRAL DENSITY

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

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

7.1 Configuration 802.11a

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Peak power spectral density with BPSK modulation (rate = 6 Mbps) was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 6 Mbps (BPSK).

Frequency MHz	Antenna Gain (dBi)	Measured dBm	Limit dBm	Result	Spectral Density plots
5745	22	-20.8	8.0	Complies	Appendix J1
5785	22	-18.7	8.0	Complies	Appendix J1
5825	22	-20.4	8.0	Complies	Appendix J1

The transmitter has an antenna gain of greater than 6 dBi. No reduction in transmitter output power is required in according to paragraph 15.247 (c)(1)(ii)

7.2 Configuration 802.11b

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

Frequency MHz	Antenna Gain (dBi)	Measured dBm	Corrected Limit dBm	Result	Spectral Density plots
2412.0	12	0.35	6.0	Complies	Appendix J2
2437.0	12	-0.63	6.0	Complies	Appendix J2
2462.0	12	-0.39	6.0	Complies	Appendix J2

The transmitter has an antenna gain of greater than 6 dBi and therefore the limit is corrected according to paragraph 15.247(c)(1)(i)

7.3 Configuration 802.11g

Initial investigations were performed with four modulation types: (BPSK, QPSK, 16QAM and 64QAM). Peak power spectral density with BPSK modulation (rate = 6 Mbps) was observed to be slightly worst. Final testing was performed while the transmitter continuously operated with the modulation rate of 6 Mbps (BPSK).

Frequency MHz	Antenna Gain (dBi)	Measured dBm	Corrected Limit dBm	Result	Spectral Density plots
2412.0	12	-15.6	6.0	Complies	Appendix J3
2437.0	12	-13.7	6.0	Complies	Appendix J3
2462.0	12	-16.1	6.0	Complies	Appendix J3

The transmitter has an antenna gain of greater than 6 dBi and therefore the limit is corrected according to paragraph 15.247(c)(1)(i)

8.0 RADIO FREQUENCY EXPOSURE (HAZARD) INFORMATION

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

Spread spectrum transmitters operating in the 2400 - 2483.5 MHz and 5725 – 5850 MHz bands are required to be operated in a manner that ensures that the public is not exposed to RF energy levels in accordance with CFR 47, Section 1.1307(b)(1).

The MPE calculation shown below is for the WLAN device with a separation distance of greater than 200cm.

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)

Prediction frequency = 2412 MHz (802.11b)
Maximum peak output power = 25.3 dBm = 338.8 mW
Antenna gain (typical) = 12 dBi = 15.85 numeric
Prediction distance = 200 cm
The power density calculated = 0.011 mW/cm^2

Prediction frequency = 2412 MHz (802.11g)
Maximum peak output power = 26.3 dBm = 426.6 mW
Antenna gain (typical) = 12 dBi = 15.85 numeric
Prediction distance = 200 cm
The power density calculated = 0.014 mW/cm^2

Prediction frequency = 5825 MHz (802.11a)
Maximum peak output power = 22.7 dBm = 186.2 mW
Antenna gain (typical) = 22 dBi = 158.5 numeric
Prediction distance = 200 cm
The power density calculated = 0.059 mW/cm^2

The worst case power density at a distance of 200 cm is: 4 x 0.059 mW/cm^2 = 0.236 mW/cm^2

MPE limit for uncontrolled exposure at prediction frequency = 1 mW/cm^2

Results: Calculations show that the Radio devices with described antennas complied with Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure

9.0 ANTENNA REQUIREMENT

This intentional radiator was designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

10.0 COMPLIANCE STATEMENT

The Intelligent Network Node, Model: RX-4002 with IEEE 802.11a/b/g Wireless Mini-PCI Adapter, Model: NMP-8602 PLUS., tested on behalf of aCure Technology Pty Ltd, **complies** with the **Class II Permissive Change** requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 - Operation in the frequency band 2400 - 2483.5 MHz and 5725 – 5850 MHz.

Results were as follows - FCC Subpart C, Section 15.247

FCC Part 15 Subpart C, Clauses	Test Performed	Results
15.203	Antenna Requirement	**Complies**
15.205	Operation in Restricted Band	**Complies**
15.207	Conducted Emissions	**Complies**
15.209	Radiated Emissions	**Complies**
15.247 (a)(2)	Channel Bandwidth	**Complies**
15.247 (b)	Peak Output Power	**Not applicable. Refer to 15.247 (c)** Antenna Gain > 6 dBi
15.247 (c)	Antenna Gain > 6 dBi	**Yes, complies**
15.247 (d)	Out of Band Emissions	**Complies**
15.247 (e)	Peak Power Spectral Density	**Complies**
15.247 (f)	*Hybrid Systems	**Not Applicable** EUT does not employ a hybrid system
15.247 (g)	Frequency Hopping	**Not Applicable** EUT does not employ a frequency hopping modulation technique
15.247 (h)	Frequency Hopping	**Not Applicable** EUT does not employ a frequency hopping modulation technique
15.247 (i)	Radio Frequency Hazard	**Complies**

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

TEST REPORT APPENDICES

APPENDIX A: MEASUREMENT INSTRUMENT DETAILS
APPENDIX B: REPORT PHOTOGRAPHS
APPENDIX C: RESERVED
APPENDIX D: FCC LABELLING DETAILS
APPENDIX E: USER MANUAL
APPENDIX F: GRAPHS OF EMI MEASUREMENT
APPENDIX G: CHANNEL BANDWIDTH PLOTS
APPENDIX H: HARMONICS PLOTS
APPENDIX I: BANDEDGE PLOTS
APPENDIX J: PEAK POWER SPECTRAL DENSITY PLOTS

Attachment 1: RF Exposure Information