



**FEDERAL COMMUNICATIONS COMMISSION**

**CFR 47, FCC PART 15, SUBPART E**  
**UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE DEVICES**

**CERTIFICATION:**

**CERTIFICATION COMPLIANCE REPORT**  
**ON**

**N2-X WIRELESS ETHERNET BRIDGE**

**NII 5.7 GHz RADIO**

CFR 47, FCC PART 15, SUBPART E, UNII INTENTIONAL RADIATORS  
CFR 47, FCC PART 15, SUBPART C, CLASS A, DIGITAL DEVICES

**PREPARED FOR:**

**WIRELESS, INC.**  
**5452 BETSY ROSS DRIVE**  
**SANTA CLARA, CA 95054-1101**

**TESTING PERFORMED BY:**

**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
**1249 BIRCHWOOD DRIVE, SUNNYVALE, CA 94089**  
**408/747-1490**

Test Report: 9110901A

Date of Test: July 12-20, 1999

If this document is reproduced, it must be reproduced in its entirety.

**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
**1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089**  
**408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS**

## Table of Contents

<b>1.0</b>	<b>Verification of Compliance</b>	<b>4</b>
<b>2.0</b>	<b>General Information</b>	<b>5</b>
2.1	Radiated Emission Test:	5
2.2	AC Line Conducted Test:	5
2.3	15.407 Operation within the 5.725-5.825GHz band:	5
<b>3.0</b>	<b>Test Facility</b>	<b>6</b>
<b>4.0</b>	<b>Test Equipment Settings</b>	<b>7</b>
4.1	Test Equipment Settings	7
<b>5.0</b>	<b>Antennas</b>	<b>7</b>
5.1	Antenna Table	7
<b>6.0</b>	<b>Test Equipment</b>	<b>8</b>
6.1	Test Equipment Table	8
<b>7.0</b>	<b>Data Reporting Format</b>	<b>9</b>
<b>8.0</b>	<b>Detector Functions</b>	<b>10</b>
8.1	Frequency Range of Investigation	10
<b>9.0</b>	<b>FCC Class Types</b>	<b>10</b>
9.1	Class A, Digital Device	10
9.2	Class B, Digital Device	10
<b>10.0</b>	<b>FCC Limits</b>	<b>11</b>
10.1	Radiated Emission Limits	11
10.2	Conducted Emission Limit	11
<b>11.0</b>	<b>Test Methods</b>	<b>13</b>
11.1	Radiated Emissions Test Procedure	13
11.2	Radiated Emissions Test Example	13
11.3	Line Conducted Emissions Test Procedure	14
11.4	Line Conducted Emissions Test Example	14
<b>12.0</b>	<b>Equipment Under Test (EUT)</b>	<b>15</b>
<b>13.0</b>	<b>SUPPORT EQUIPMENT</b>	<b>15</b>
<b>14.0</b>	<b>EQUIPMENT CONFIGURATION</b>	<b>16</b>
14.1	Radiated Emissions Testing (OATS)	16
14.2	Radiated Emissions Testing (OATS)	16
14.3	Conducted Measurements	16
<b>15.0</b>	<b>SUMMARY OF TESTS</b>	<b>17</b>
15.1	15.407(a)(2) Peak Transmit Power	17
15.2	15.407(a)6	18
15.3	15.407(b)(3) OUT OF BAND EMISSIONS	18
15.4	15.205 RESTRICTED BAND RADIATION LIMITS	19
15.5	15.209 RADIATED EMISSIONS	19
15.6	15.207 AC LINE CONDUCTED EMISSIONS	19
15.7	15.203 ANTENNA REQUIREMENT	19
<b>APPENDIX A</b>		<b>20</b>
	RADIATED EMISSIONS	20

<b>APPENDIX B</b>	21
TEST METHODOLOGY	21
<b>APPENDIX C</b>	22
PEAK POWER MEASUREMENTS	22
<b>APPENDIX D</b>	23
OUT OF BAND PLOTS AND DATA	23
<b>APPENDIX E</b>	24
TEST SET-UP PHOTOS	24
<b>APPENDIX f</b>	25
RESTRICTED BAND MEASUREMENTS	25
<b>APPENDIX G</b>	26
ANTENNA INFORMATION	26
<b>APPENDIX H</b>	27
LABELING REQUIREMENTS	27
<b>APPENDIX I</b>	28
EUT PHOTOGRAPHS	28
<b>APPENDIX J</b>	29
PROPRIETARY INFORMATION	29



## 1.0 Verification of Compliance

**Description:** The N2-X is a point to point Wireless Ethernet Bridge operating in the 5.3/5.7 GHz NII Band. The unit has an integrated radio, which operates in a full duplex mode, transmitting and receiving data over distances up to 8km.

**Model Number:** N2-X 5.7GHz Transmitter

**Serial Number:** pre-production prototype # 002

**Applicant:** Wireless, Inc.

**Type of Test:** CFR 47 FCC Part 15, Subpart B, Class A (Verification)  
15.407 Subpart E, Unlicensed NII Devices, Certification,  
Radiated and Conducted Emissions

**Registration:** NVLAP Code: 200089

**Date of Test:** July 12-22, 1999

**Tested By:** Suresh Kondapolli, Jook Lee, Chip Matheny

The above equipment was tested by Electronic Compliance Laboratories, Inc. and found to be in compliance with the requirements set forth in the CFR 47 FCC Rules and Regulations, Part 15 (Digital Devices) Part(s) 15.401 through 15.407 for Unlicensed National Information Infrastructure ("U-NII") Devices. The equipment, in the configuration described in this report, shows that the maximum emission levels emanating from this equipment are within the compliance requirements.

A blue ink signature of Chip Matheny, consisting of a stylized 'C' and 'M'.

**Chip Matheny**  
Technical Officer

**Date:** 09/22/99

**Bill Anderson**  
Vice President of Technology

**Date:** 09/25/99

## 2.0 General Information

**Applicant:** *Wireless, Inc.*  
*5452 Betsy Ross Drive*  
*Santa Clara, California 95054-1101*

**Contact:** Bill Anderson                      **Telephone:** 408/727-8383

**E.U.T.:** N2-X 5.3 / 5.7 GHz Full Duplex Radio Device

**FCC Identifier:** EV9N2X5-7S1-16B

**Model Number:** N2-X

**Serial Number:** Pre-production Prototype #002

**Report Number:** 9110901A

**Date of Test:** July -Aug, 1999

**Manufacturer:** Wireless, Inc.

**Type of Test:** FCC Part 15, Subpart B, Class B, 15.401-15.407, Subpart E  
Radio Frequency Device (UNII) Certification

**Frequency Range:** 450 kHz to 30 MHz – Line Conducted Emissions  
30 MHz to 1000 MHz - Radiated Emissions  
2400 MHz to 40 GHz – Part 15.407

**Summary**                      **Pass/Fail:** **PASSED**

### 2.1 Radiated Emission Test:

The **N2-X** was placed on a 10-meter (OATS) Open Field Test Site. All emissions observed were below the applicable limit for Part 15, subpart B, Class B Digital Devices. The remainder of the Radiated testing was performed here as well. The emissions observed were below the FCC Part 15, Class A limit. Although, no emissions were detectable above the noise floor the test results are in **Appendix A**. See section 15.0 "Summary of Measurements" section, later in this report for results and appendices for reference.

### 2.2 AC Line Conducted Test:

The **N2-X** was placed in a screen room and connected to AC power through a LISN. All other associated peripherals and support equipment were connected to a separate power source. All emissions observed were below the FCC Class B limit. Test results are in **Appendix B**.

### 2.3 15.407 Operation within the 5.725-5.825GHz band:

The **N2-X** met all the requirements. See data and plots in Appendices.

## 3.0 Test Facility

**Name:** Electronic Compliance Laboratories, Inc.

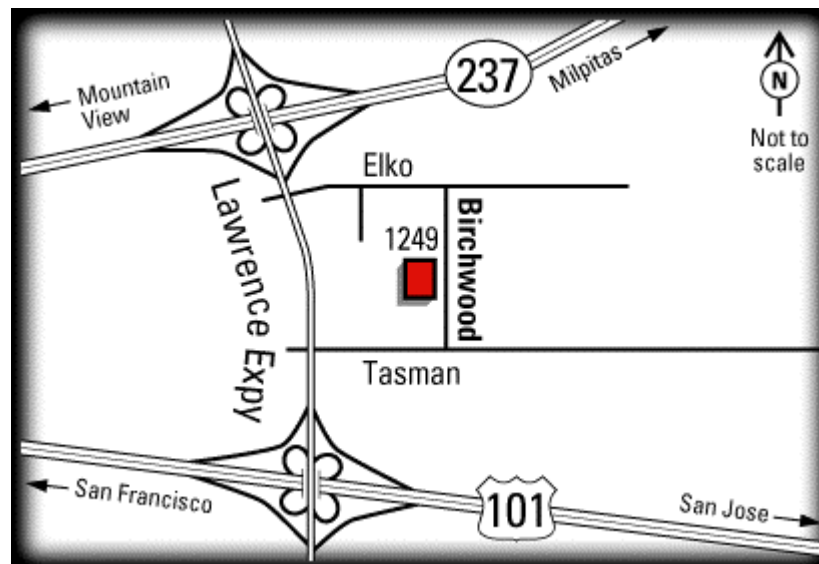
**Location:** 1249 Birchwood Drive  
Sunnyvale, CA 94089

**Site Filing:** A site description is on file at the;  
Federal Communications Commission  
P.O. Box 429  
Columbia, MD 21045

**Types of Sites:** Open Field Radiated and Indoor (Screen Room). Line Conducted:  
All sites are constructed and calibrated to meet ANSI C63.4-1994 requirements. Test facility is recognized by the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations.

**NVLAP Code:** 20089 effective through: March 31, 2000

### LOCATION OF THE SUNNYVALE TEST FACILITY



[www.eclabs.com](http://www.eclabs.com)  
800/707-LABS

## 4.0 Test Equipment Settings

### 4.1 Test Equipment Settings

Parameter	Line Conducted Emissions	Radiated Emissions
Bandwidth	9 kHz	120Khz
*Detector Mode	Peak	Peak

\*Unless otherwise specified

#### Units of Measurement

Measurements of radiated emissions are reported in terms of microvolts per meter or in dBuV/m at a specified distance. The indicated readings on the spectrum analyzer are converted to microvolts per meter or to dBuV/m by the use of appropriate conversion factors. Measurements of conducted interference are reported in units of microvolts or dBuV.

## 5.0 Antennas

### 5.1 Antenna Table

Antenna Type	Frequency Range
Biconical	25 to 300 MHz
Log Periodic	300 to 1000MHz
Horn Double Ridge	1 to 18GHz
Horn Parabolic	4.9 to 10GHz
Horn Polarad	4.7 to 7.74GHz
Horn Polarad	8.3 to 10GHz

Correction Factors: Programmed into the software  
Antenna Height: Varied from 1 to 4 meters above the ground plane  
Polarization: Vertical/Horizontal

**Note:** The antenna used at the time that the data was taken is indicated on each data page in the appendices. The correction factors and antenna polarization are also noted on each data page.

## 6.0 Test Equipment

The following list contains equipment used at EC Laboratories, Inc. for compliance testing. The equipment conforms to the American National Standard Specifications for Electromagnetic Interference and Field Strength Instrumentation from 10 kHz to 1000 MHz.

### 6.1 Test Equipment Table

Description	Manufacturer	Serial No.	Model No.
EMI Receiver	HP	3325A00137	8546A
Peak Power Meter	HP	2131A01013	8900C
Power Sensor	HP	2551A01618	84811A
Spectrum Analyzer	HP	3137A01183	8563A
Spectrum Analyzer	HP	3741A00986	8564E
Pre-amp	HP	3113A05849	8447F
Pre-amp	HP	3008A00527	8449B
LISN	EM	2532	ANS-25/2
Biconical Antenna	EM	677	EM-6912
Log-Periodic Antenna	EM	858	EM-6950
Double Ridge Horn	EM	6231	EM 6961
Filter BP 1.2-4 GHz	FSY	001	HM1160-11SS
Filter BP 4-10 GHz	FSY	213	HM2950-15SS
Filter BP 10-18 GHz	FSY	001	HP8601-7SS
Filter BP 18-26 GHz	FSY	078	C21G-6.7G4SS

HP = Hewlett Packard  
EM = Electro Metrics  
FSY = FSY Microwave

Antennas used at the time the data was taken is indicated on each data page.  
Antenna height and polarization are also noted on the data pages.

Calibration of the measuring instruments, including any accessories that may effect such calibration, are checked frequently to assure their accuracy. Adjustments are made and correction factors applied in accordance with instructions contained in the manual for the measuring instrument. All equipment is calibrated per EC Labs' Test Equipment Calibration Schedule as required per EN 45001 and NVLAP Accreditations.



## 7.0 Data Reporting Format

The measurement results are expressed in accordance with FCC Part 15 Subpart B Class A limits, where applicable, are presented in tabular or graphical form.

### 7.1 Operating Conditions

The EUT was operated at the specified load conditions (mechanical and/or electrical) for which it was designed.

### 7.2 Conditions of the EUT

The EUT was operated for a sufficient period of time to approximate normal operating conditions.

### 7.3 Test Configuration

The equipment under test was configured and operated in a manner that tends to maximize its emission characteristics in a typical application. Power and signal distribution, ground, interconnecting cabling and physical placement of equipment were simulating the typical application and usage in so far as practicable. The EUT was furnished with rated voltage as specified by the manufacturer in the individual equipment's power requirements.

### 7.4 Test Platform

The EUT was placed on a non-conductive table having a height of 1 meter above the test site ground.

### 7.5 Maximization of Emissions

The test platform was rotated 360 degrees along with the moving of cabling and/or equipment in order to determine the maximum level of emissions.

### 7.6 Temperature

The ambient temperature of the testing location was within the range of 10 to 40 degrees Centigrade (50 to 104 Degrees Fahrenheit).

### 7.7 Temperature Conditional Testing

The EUT was operated for 24 hour period cycling through extreme temperature conditions. See table in **Appendix H**.

## 8.0 Detector Functions

On any frequency or frequencies below or equal to 1000 MHz, the limits shown below are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths.

On any frequency or frequencies above 1000 MHz, the radiated limits shown below are based on the use of measuring equipment employing an average detector function.

EC Laboratories uses the Peak detection mode for normal testing and initial screening of the EUT. The Peak detection mode will produce a measurement value that is always greater than, or equal to, the quasi-peak or average detection mode. Whenever the measurement value is 6 dB below the applicable limit or greater, the appropriate detector function will be employed and recorded.

### 8.1 Frequency Range of Investigation

The spectrum was investigated up to the frequency specified in the following table according to the highest clock frequency generated in the device.

Highest Frequency Used (Clock)	Upper Limit of Range Measured
Below 1.705 MHz	30 MHz
1.705 to 108 MHz	1000 MHz
108 to 500 MHz	2000 MHz
500 to 1000 MHz	5000 MHz
Above 1000 MHz	5th Harmonic or 40 GHz (Whichever is Lower)

## 9.0 FCC Class Types

### 9.1 Class A, Digital Device

A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

### 9.2 Class B, Digital Device

A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

Note: The responsible party may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B device, and in fact

is encouraged to do so, provided that the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

(Code of Federal Regulations, Part 15, Subpart A, Sect. H&I)  
(CFR 47, Parts 0 to 19, Revised as of October 1, 1990)

## 10.0 FCC Limits

### 10.1 Radiated Emission Limits

The field strength of radiated emissions for a Class A Digital Device, when measured at a distance of 10 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

The field strength of radiated emissions for a Class B Digital Device, when measured at a distance of 3 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

<u>Frequency</u> <u>(MHz)</u>	<u>Class A</u> <u>(3m) Limit</u> <u>(<math>\mu</math>V/m)</u>	<u>Class A</u> <u>(3m) Limit</u> <u>(dB<math>\mu</math>V/m)</u>	<u>Class A</u> <u>(10m) Limit</u> <u>(<math>\mu</math>V/m)</u>	<u>Class A</u> <u>(10m) Limit</u> <u>(dB<math>\mu</math>V/m)</u>	<u>Class B</u> <u>(3m) Limit</u> <u>(<math>\mu</math>V/m)</u>	<u>Class B</u> <u>(3m) Limit</u> <u>(dB<math>\mu</math>V/m)</u>
30-88	300	49.6	90	39.1	100	40.0
88-216	500	54.0	150	43.5	150	43.5
216-960	700	56.0	210	46.4	200	46.0
Above 960	1000	60.0	300	49.5	500	54.0

### 10.2 Conducted Emission Limit

For a digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back into the AC power line on any frequency or frequencies within the band 450kHz to 30MHz shall not exceed the limits in the following table for the appropriate class. Compliance shall be based on the measurement of the Radio Frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

<u>Frequency</u> <u>(MHz)</u>	<u>Class A Limit</u> <u>(<math>\mu</math>V)</u>	<u>Class A Limit</u> <u>(dB<math>\mu</math>V)</u>	<u>Class B Limit</u> <u>(<math>\mu</math>V)</u>	<u>Class B Limit</u> <u>(dB<math>\mu</math>V)</u>
----------------------------------	--	--	--	--

0.45 to 1.705	1000	60.0	250	48.0
1.705 to 30.0	3000	69.5	250	48.0

## 11.0 Test Methods

### 11.1 Radiated Emissions Test Procedure

- (1) EUT and any other equipment and cables used with the EUT are placed on a non-conductive table 1-meter above a ground plane.
- (2) The EUT receives the normal AC Power at the base of the table.
- (3) All equipment and cables are placed in a manner, which tends to maximize their emission characteristics in a typical application.
- (4) The table is rotated 360 degrees to determine the maximum radial emissions.
- (5) The antenna height is varied between 1 meter and 4 meters above the ground plane to determine the maximum emissions. Appropriate antennas are used during the test in both the vertical and horizontal polarization.
- (6) The Spectrum Analyzer is scanned from 30 MHz to 1000 MHz for emissions. The applicable spectrum analyzer settings are:
  - a). Resolution Bandwidth = 100 kHz,
  - b). Normal Detector Mode = Peak (The Quasi-Peak is used when the emissions are near, or over the limit).
- (7) When an emission is found and maximized, the following actions are performed:
  - a). The emission frequency is entered into the computer.
  - b). The emission level is read from the spectrum analyzer in dBm and entered into the computer.
  - c). The antenna polarization is entered into the computer.
  - d). The computer converts the level in dBm to dB $\mu$ V and uses lookup tables to determine the coax cable loss, antenna factor, and pre-amp gain. A site correction factor is calculated for that particular frequency, and the data is printed out in tabular form.

### 11.2 Radiated Emissions Test Example

FREQ	SITE			FCC Limit		EUT Level (L1)	
MHz	Raw (dBm)	CF (dB)	Corr'd (dB $\mu$ V)	Class A (dB $\mu$ V)	Class B (dB $\mu$ V)	Class A (dB)	Versus Class B (dB)
65.4	-58	-14.5	34.5	39.1	40.0	-4.6	-5.5

Frequency = Frequency of emission in MHz  
 Raw dBm = Reading at Spectrum Analyzer (uncorrected)  
 Site CF = Correction Factor for coax/antenna/pre-amp for that frequency.  
 Note that a negative CF is the result of the gain of the pre-amp.  
 Corr'd dB $\mu$ V = Corrected emission level in dB $\mu$ V  
 FCC Limit A / B = Limit as stated in Part-15, Subpart B  
 EUT Level A\* = Emission relative to the FCC Class A Limit.  
 EUT Level B\* = Emission relative to the FCC Class B Limit.

Note: V/H is the antenna polarization (Vertical or Horizontal)  
 QP indicates the Quasi-Peak value.

\*A negative value indicates that the emission is below (or meets) the limit and a positive value indicates that the emission is above (or exceeds) the limit.

### 11.3 Line Conducted Emissions Test Procedure

1. EUT and any other equipment and cables were placed on a non-conductive table one meter above a ground screen.
2. The EUT's Input Power line cord was connected to a Line Impedance Stabilization Network (LISN).
3. All other (Non-EUT) equipment received power from a separate AC Power Source. The LISN assembly has two monitoring points: Line 1 (AC-Hot) and Line 2 (AC-Neutral). Each monitoring point was scanned by the measuring equipment (the other point was terminated in 50 ohms) over the frequency range of 450kHz to 30MHz for conducted emissions.
4. When an emission is found, the following takes place:
  - a. The emission levels are maximized by equipment/cable placement.
  - b. Frequency and emission level data are entered into computer in dBm.
  - c. The monitoring point (Line 1 or 2) is entered into the computer.
  - d. The computer converts dBm to micro volts and uses a look-up table to find cable losses (in dB) at that frequency, calculates a corrected emission level, and compares the corrected emission level to the appropriate limit. The data is then printed out in tabular form.

An example of the printout and definitions follows:

### 11.4 Line Conducted Emissions Test Example

FREQ	SITE			FCC Limit		EUT Level (L1)	
MHz	Raw (dBm)	CF (dB)	Corr'd (dBμV)	Class A (dBμV)	Class B (dBμV)	<u>A</u> (dB)	<u>B</u> (dB)
1.85	-57	15.0	65.0	69.5	48.0	-4.5	+17

Frequency = Frequency of emission in MHz  
 Raw dBm = Reading at Spectrum Analyzer (uncorrected)  
 Site CF = Correction Factor for cable loss  
 Corr'd dBuV = Corrected emission level in dBuV  
 FCC Limit A / B = Conducted Emission level limit in dBμV  
 EUT Level 1\* = Emission relative to the FCC Class A Limit  
 EUT Level 2\* = Emission relative to the FCC Class B Limit

*Note:* L1 is AC-Hot, L2 is AC-Neutral  
 QP is a Quasi-Peak value  
 AV is an Average value

\*A negative value indicates that the emission is below (or meets) the limit and a positive value indicates that the emission is above (or exceeds) the limit.

## 12.0 Equipment Under Test (EUT)

The N2-X is a point to point Wireless Ethernet Bridge operating in the 5.3/5.7 GHz NII Band. The unit has an integrated radio, which operates in a full duplex mode, transmitting and receiving data over distances up to 8km.

The unit is equipped from the factory with four (4) output power settings for each of the eight (8) transmit channels available. The levels change approximately 3 dB between each of the settings, a total of 9 dB of power variation from the highest power to the lowest level. These four (4) power settings directly correspond to gain of the four (4) antennas presently being submitted for Certification under this application filing. The variance in power level setting combined with the difference in gain, from the antenna types, provides the manufacturer with the desired flexibility required to offer their customers with cost effective solutions for the lack connectivity to the vast range of information and resources available via the Internet. The same flexibility was required by the manufacturer to meet the regulatory compliance issues with respect to the EIRP limits specified. The N2-X was tested and will ship with, a standard six (6) foot coaxial cable which contributes approximately 2.6 dB of Loss which provides a near optimal receiver noise figure for any of the four (4) antennas submitted with this application. Thus providing the customers the best cost performance tradeoff options for links of varying distances and geographical or geometrical specific burdens.

## 13.0 SUPPORT EQUIPMENT

Equipment Type: Laptop Computer  
Model Number: ThinkPad 2635  
Serial Number: 78-HLI3097/11  
Manufacturer: IBM ThinkPad  
Comments:

Equipment Type: EtherNet Switch  
Model Number: FS3208  
Serial Number: 61-10141-00-C  
Manufacturer: Asante Technologies  
Comments:

## 14.0 EQUIPMENT CONFIGURATION

### 14.1 Radiated Emissions Testing (OATS)

All of the equipment and cables were placed in worst case positions to maximize emissions.

Interconnecting cables were of the type and length specified in the individual equipment requirements.

Grounding was in accordance with the manufacturer's requirements and conditions for intended use.

### 14.2 Radiated Emissions Testing (OATS)

The EUT was placed on a wooden table approximately 1 meter in height located on the center of the 3 meter turntable where it was configured and set up to operate and function for normal performance, intended to simulate the application in the field. A tripod was set up directly in front of the EUT where the antennas were mounted, tested and the measurements were then referenced to the applicable specifications in FCC Part(s) 15. A detailed description of the testing methodology and the results are available later in this report and photographs of the actual test set-up can be found in **Appendix E**. Test methods and information are outlined in Section 15.0, directly following. Results of the measurements and conclusions can be found in the specified Appendices.

### 14.3 Conducted Measurements

Refer to the following Section (15.0) for a detailed description of the testing methodology and results. Photographs of the set-up configurations can also be found in **Appendix E**.



## 15.0 SUMMARY OF TESTS

The **N2-X Wireless Ethernet Bridge** is a wireless point to point communications system operating in the 5.3/5.7 GHz range. This operation falls under NII as authorized in CFR 47, FCC Rules and Regulations, Part(s) 15.400- 15.407. The Unit's design is intended to provide data links over distances up to 8km and has been designed in a weatherproof outdoor enclosure. The **N2-X** transmits and receives at rate of 8.192 Mbits/sec. and operates in the full duplex mode. The radio modulates using 25% excess bandwidth BPSK resulting in a transmitter -3dB bandwidth of approximately 9 MHz, and a -26 dB bandwidth of approximately 13 MHz. The **N2-X** transmits in the 5.725-5.825GHz band, and receives in the band 5.225 to 5.335 GHz, with a low power radio system operating in the 5.725-5.825GHz band. Tests were performed using four (4) different types of antennas, all manufactured by Gabriel Electronics, Inc. with various levels of gain (dBi). See data sheets provided in **Appendix F**. Test firmware resident in the EUT was used to do the test.

### 15.1 15.407(a)(2) Peak Transmit Power

The N2-X was set to transmit continuously on it's low, middle, and high frequency via the channel selection dip switches, located in the rear of the unit. Refer to EUT photographs in **Appendix G** for details. The 26dB bandwidth was measured for each frequency. The peak transmit power limit is the lesser of either 24dBm (250mW) or 11dBm + 10Log(26 dB BW) as shown in data sheets provided in **Appendix B**. The peak transmit power limit was reduced by the number of dB that the antenna gain exceeded 6dBi. The data sheets also include the same calculations for each of the antennas submitted with this application.

The power was measured by setting RBW to 1MHz and VBW to 30MHz. The analyzer span was set to 1 MHz, the trace set for Max Hold, and the frequency set to the center of the selected EUT frequency. The peak reading of the analyzer was recorded. The analyzer frequency was the shifted by 1 MHz and the procedure was repeated. This was done for 10 MHz on each side of the EUT frequency. Table 1 shows the results for each frequency. Data Sheets are available for review in **Appendix B**.

Freq. (GHz)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Limit (dBm) based on 26 dB BW	Limit - Excess Antenna Gain (dBm)	Delta
5.73	-3.32	28.5	21.7	-1.6	-1.7
5.77	-4.24	28.5	21.1	-1.4	-2.8
5.80	-1.82	28.5	20.9	-1.6	-0.2

Table 1. Peak Transmit Power vs. Limit

### Peak Spectral Power Density

Peak Power Spectral Density measurements were taken at the same time as the output power. The peak spectral density limit is 11 dBm in any 1 MHz band. This limit is reduced by the number of dB that the antenna gain exceeds 6 dBi, making the limit -11.5 dBm. The **N2 - X** does not meet the specification at the three mid points for each frequency. Data Sheets are shown in **Appendix B**.

**15.2 15.407(a)6**

Ratio of the peak excursion of the modulation envelope to the peak transmit power shall not exceed 13 dB.

Freq. (GHz)	Peak Transmit Power (dBm)	Peak Excursion Power (dBm)	Delta	Limit (dB)
5.73	-3.32	3.17	6.49	13
5.77	-4.24	-1.17	3.07	13
5.80	-1.82	2.17	3.99	13

**15.3 15.407(b)(3) OUT OF BAND EMISSIONS**

The spectrum analyzer plots titled " OUT OF BAND - LOWER BAND EDGE " shows the output spectrum of the EUT when set to it's lowest transmitting frequency. The spectrum analyzer plots titled " OUT OF BAND - UPPER BAND EDGE" shows the output spectrum of the EUT when set to it's highest transmitting frequency. The analyzer was placed in MAX HOLD mode, and several sweeps were recorded. The resultant plots show that the EUT emissions were at least 60 dB down from the band edges to 10MHz above and below the band edges.

The spectrum analyzer plots titled " OUT OF BAND - LOWER BAND EDGE + 10MHz" shows the output spectrum of the EUT when set to it's lowest transmitting frequency. The spectrum analyzer plots titled "" OUT OF BAND - UPPER BAND EDGE + 10 MHz" shows the output spectrum of the EUT when set to it's highest transmitting frequency. The analyzer was placed in MAX HOLD mode, and several sweeps were recorded. The resultant plots show that the EUT emissions were at least 60 dB down for frequencies greater than 10 MHz above and below the band edges.

The spreadsheet in **Appendix B** shows the EIRP of the out of band emissions, up to 20 MHz away from the band edge, is better than -27 dBm / MHz.

The spectrum analyzer plots labeled "OUT OF BAND <30 MHz - 6 GHz", " OUT OF BAND 6 - 13 GHz", "OUT OF BAND 13 - 26.5 GHz", "OUT OF BAND 26.5 - 31GHz", and "OUT OF BAND 31 - 40 GHz", show that emissions measured in  $\geq 100$  kHz bandwidth are more than 20 dB below the highest level of the desired power outside of the 5.725 - 5.825 GHz band. Test data and plots are shown in **Appendix B**.

#### 15.4 15.205 RESTRICTED BAND RADIATION LIMITS

The EUT was placed on a wooden table resting on a turntable. The wooden table was approximately 1 meter above the ground plane of the 3 meter test site. The search antenna was moved in to 1 meter when necessary to improve the noise floor, and the appropriate range factor was applied. While the EUT was transmitting uninterrupted random data on each of the low / mid / high channels and with the spectrum analyzer on MAX HOLD, the turntable was rotated, and the search antenna raised and lowered in an attempt to maximize the received radiated emission level. Test results are attached in **Appendix D** in tabular form showing that no spurious signals were detected above the 74 dBuV/m peak / 54dBuV/m average limits. Peak measurements were made with a RBW and VBW = 1 MHz. Average measurements were made with a RBW = 1 MHz and a VBW = 10 Hz. The **N2-X** harmonics were only measured up to 3rd due to measuring equipment limitations. The Out of Band plots in **Appendix C** indicate that no harmonics are seen above the noise floor.

#### 15.5 15.209 RADIATED EMISSIONS

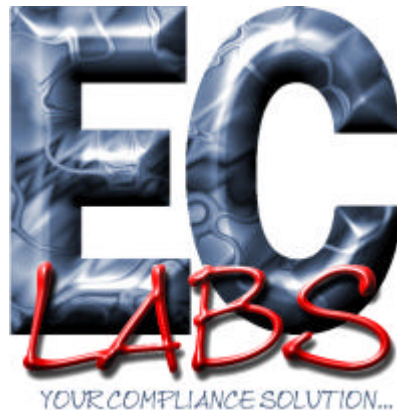
The attached table shows that the Class A radiated limits from 30 - 1000 MHz are not exceeded by the EUT. The EUT was set in a "receive only" mode during this test. The EUT was placed near one edge of a wooden table resting on a turntable. The wooden table was approximately 1 meter above the ground plane of the 3 meter test site. The search antennas were located at 3 meters. Measurements were made in accordance with ANSI C63.4-1994. Test Data provided in **Appendix A**.

#### 15.6 15.207 AC LINE CONDUCTED EMISSIONS

The RF line conducted levels for emissions in the 0.45 - 30 MHz band must not exceed 250  $\mu$ V when measured with a LISN. Attached graphs and tabular data show that emissions are below the 250  $\mu$ V (48 dB $\mu$ V) maximum allowed level. Test Data is in **Appendix B**.

#### 15.7 15.203 ANTENNA REQUIREMENT

The unit requires professional installation and is therefore exempt from the requirements of 15.203. This product has a standard N type Antenna connector to provide a coupling to the intentional radiator.



## APPENDIX A

### RADIATED EMISSIONS

#### CONTENTS:

FCC PART 15, SUBPART C, CLASS A, DIGITAL DEVICES  
RADIATED EMISSIONS DATA, 30 MHz – 1GHz

#### INFORMATION

\* **CLIENT:** **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* **CONTACT:** **BILL ANDERSON** 408/727-8383  
\* **PRODUCT:** ***N2-X 5.7 GHz ETHERNET EXTENDER (BRIDGE)***  
\* **REPORT FILE:** 9080502A  
\* **FILE NAME:** APPENDIX A  
\* **DATE:** 9/12/99  
\* **SUBMITTED BY:** **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* **CONTACT:** **CHIP MATHENY** 408/747-1490 [CHIP@ECLABS.COM](mailto:CHIP@ECLABS.COM)



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
**1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089**  
**408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS**



## APPENDIX B

### TEST METHODOLOGY

#### CONTENTS:

#### DESCRIPTION OF TEST METHODS

#### INFORMATION

\* **CLIENT:** **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* **CONTACT:** **BILL ANDERSON** 408/727-8383  
\* **PRODUCT:** ***N2-X 5.7 GHZ ETHERNET EXTENDER (BRIDGE)***  
\* **REPORT FILE:** 9080502A  
\* **FILE NAME:** APPENDIX B  
\* **DATE:** 9/12/99  
\* **SUBMITTED BY:** ELECTRONIC COMPLIANCE LABORATORIES, INC.  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* **CONTACT:** **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
**1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089**  
**408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS**



## APPENDIX C

### PEAK POWER MEASUREMENTS

#### INFORMATION

\* **CLIENT:** **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* **CONTACT:** **BILL ANDERSON** 408/727-8383  
\* **PRODUCT:** ***N2-X 5.7 GHZ ETHERNET EXTENDER (BRIDGE)***  
\* **REPORT FILE:** 9080502A  
\* **FILE NAME:** APPENDIX C  
\* **DATE:** 9/12/99  
\* **SUBMITTED BY:** **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* **CONTACT:** **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089  
408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS

CLIENT CONFIDENTIAL



## APPENDIX D

### OUT OF BAND PLOTS AND DATA

#### INFORMATION

\* **CLIENT:** **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* **CONTACT:** **BILL ANDERSON** 408/727-8383  
\* **PRODUCT:** ***N2-X 5.7 GHZ ETHERNET EXTENDER (BRIDGE)***  
\* **REPORT FILE:** 9080502A  
\* **FILE NAME:** APPENDIX D  
\* **DATE:** 9/12/99  
\* **SUBMITTED BY:** **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* **CONTACT:** **CHIP MATHENY** 408/747-1490 [CHIP@ECLABS.COM](mailto:CHIP@ECLABS.COM)

**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089  
408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS



CLIENT CONFIDENTIAL

## APPENDIX E

### TEST SET-UP PHOTOS

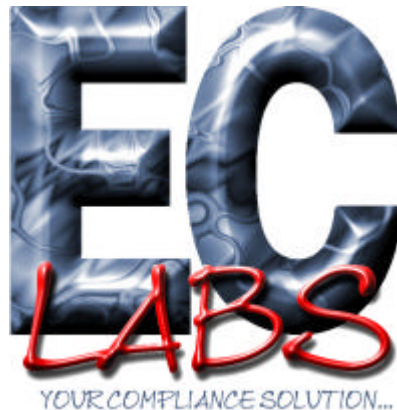
#### INFORMATION

\* CLIENT: **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* CONTACT: **BILL ANDERSON** 408/727-8383  
\* PRODUCT: ***N2-X 5.7 GHZ ETHERNET EXTENDER (BRIDGE)***  
\* REPORT FILE: 9080502A  
\* FILE NAME: APPENDIX E  
\* DATE: 9/12/99  
\* SUBMITTED BY: **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* CONTACT: **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM







## APPENDIX f

### RESTRICTED BAND MEASUREMENTS

#### CONTENTS:

FCC PART 15, SUBPART C, CLASS A, DIGITAL DEVICES  
RADIATED EMISSIONS DATA, 30 MHz – 1GHz

## INFORMATION

\* **CLIENT:** **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* **CONTACT:** **BILL ANDERSON** 408/727-8383  
\* **PRODUCT:** ***N2-X 5.7 GHZ ETHERNET EXTENDER (BRIDGE)***  
\* **REPORT FILE:** 9080502A  
\* **FILE NAME:** APPENDIX F  
\* **DATE:** 9/12/99  
\* **SUBMITTED BY:** **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* **CONTACT:** **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
**1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089**  
**408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS**



## APPENDIX G

### ANTENNA INFORMATION

#### INFORMATION

\* **CLIENT:** **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* **CONTACT:** **BILL ANDERSON** 408/727-8383  
\* **PRODUCT:** ***N2-X 5.7 GHz ETHERNET EXTENDER (BRIDGE)***  
\* **REPORT FILE:** 9080502A  
\* **FILE NAME:** APPENDIX G  
\* **DATE:** 9/12/99  
\* **SUBMITTED BY:** **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* **CONTACT:** **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089  
408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS



## APPENDIX H

### LABELING REQUIREMENTS

#### INFORMATION

\* CLIENT: **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* CONTACT: **BILL ANDERSON** 408/727-8383  
\* PRODUCT: ***N2-X 5.7 GHZ ETHERNET EXTENDER (BRIDGE)***  
\* REPORT FILE: 9080502A  
\* FILE NAME: APPENDIX H  
\* DATE: 9/12/99  
\* SUBMITTED BY: **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* CONTACT: **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089  
408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS

CLIENT CONFIDENTIAL



## APPENDIX I

### EUT PHOTOGRAPHS

#### INFORMATION

\* CLIENT: **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* CONTACT: **BILL ANDERSON** 408/727-8383  
\* PRODUCT: ***N2-X 5.7 GHZ ETHERNET EXTENDER (BRIDGE)***  
\* REPORT FILE: 9080502A  
\* FILE NAME: APPENDIX I  
\* DATE: 9/12/99  
\* SUBMITTED BY: **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* CONTACT: **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089  
408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS

CLIENT CONFIDENTIAL



## APPENDIX J

### PROPRIETARY INFORMATION

#### INFORMATION

\* CLIENT: **WIRELESS, INC.** 5452 BETSY ROSS DRIVE, SANTA CLARA, CA 95054  
\* CONTACT: **BILL ANDERSON** 408/727-8383  
\* PRODUCT: ***N2-X 5.7 GHz ETHERNET EXTENDER (BRIDGE)***  
\* REPORT FILE: 9080502A  
\* FILE NAME: APPENDIX H  
\* DATE: 9/12/99  
\* SUBMITTED BY: **ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089

\* CONTACT: **CHIP MATHENY** 408/747-1490 CHIP@ECLABS.COM



**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089  
408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS

CLIENT CONFIDENTIAL

client: Wireless, Inc.  
fcc id: EV9N2X5-7S1-16B

**ELECTRONIC COMPLIANCE LABORATORIES, INC.**  
1249 BIRCHWOOD DRIVE, SUNNYVALE, CALIFORNIA 94089  
408/747-1490 [www.eclabs.com](http://www.eclabs.com) 800/707-LABS

CLIENT CONFIDENTIAL

Filename: 9110901A  
Directory: F:\REPORTS\FCC Submittals\WIRELESS 5.7  
Template: C:\WORK\templates\Normal.dot  
Title: FCC Part 15.407 Report  
Subject:  
Author: Electronic Compliance Labs, Inc.  
Keywords:  
Comments:  
Creation Date: 11/15/99 7:24 PM  
Change Number: 3  
Last Saved On: 11/15/99 7:38 PM  
Last Saved By: Chip Matheny  
Total Editing Time: 15 Minutes  
Last Printed On: 11/16/99 10:36 AM  
As of Last Complete Printing  
Number of Pages: 30  
Number of Words: 5,193 (approx.)  
Number of Characters: 29,601 (approx.)