

**15.247 Certification  
FCC ID: EV9WNIP2458C**

**EMI TEST REPORT**

**On**

**WAVENET IP 2458 CENTRAL ROUTER**

**Prepared for**

**Wireless Inc.  
19 Davis Drive  
Belmont CA 94002  
Tel: (650) 595-3300  
Fax: (650) 595-4907**

**Prepared by**

**Electronic Compliance Laboratories Inc.  
1249 Birchwood Dr.  
Sunnyvale, CA 94089  
Tel: (408) 747-1490  
Fax: (408) 747-1495**

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## 1.0 TEST FACILITY

Name: Electronic Compliance Laboratories

Location: 1249 Birchwood Dr.  
Sunnyvale, CA 94089

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

NVLAP LAB CODE: 200089

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.

## 2.0 TEST EQUIPMENT

| Description          | Manufacturer | Model        | SN         |
|----------------------|--------------|--------------|------------|
| Spectrum Analyzer    | HP           | 8564E        | 3741A00986 |
| EMI Receiver         | HP           | 8546A        | 3325A00137 |
| Spectrum Analyzer    | HP           | 8563A        | 3137A01183 |
| Preamplifier         | HP           | 8447F        | 3113A05849 |
| Preamplifier         | HP           | 8449B        | 3008A00527 |
| LISN                 | EM           | ANS-25/2     | 2532       |
| Biconical Antenna    | EM           | EM 6912      | 414        |
| Log Periodic Ant     | EM           | EM 6950      | 311        |
| Double Ridge Horn    | EM           | EM 6961      | 6231       |
| Filter BP 1.2-45 GHz | FSY          | HM 1160-1155 | 001        |
| Filter BP 4-10 GHz   | FS4          | HM 2950-1565 | 001        |
| Filter BP 10-18 GHz  | FSW          | HP 8601- 7SS | 001        |

## 3.0 EUT

WAVENET IP 2458 CENTRAL ROUTER  
M/N:WaveNet IP 2458  
S/N: 2-C  
FCC ID: EV9WNIP2458C

## 4.0 SUPPORT EQUIPMENT

Laptop Toshiba T1900S S/N 11453067  
Laptop Power Supply  
Power Supply for EUT 110V 60 Hz to 24VAC

## 5.0 EQUIPMENT CONFIGURATION

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 requirements and conditions for intended use.

## 6.0 SUMMARY OF TESTS

The WAVENET IP 2458 CENTRAL ROUTER is a Wireless Point to Multipoint data communications System with a low power frequency hopping spread spectrum (FHSS) radio system transmitting in the 2400-2483.5 MHz band and receiving in the 5725-5850 MHz band. Tests were performed with four different pairs of antennas. Test firmware resident in the EUT and was used to do the test.

### 6.1 15.247(a)(1) FREQUENCY HOPPING SYSTEMS

WAVENET IP 2458 CENTRAL ROUTER uses 79 channels, each 1 MHz wide. The system hops over one of 26 pseudorandom sequences. On average, each channel is used equally. Please refer to "WaveNet IP System Description attached to this submission for more details.

#### 6.1.1 15.247(a)(1)(ii) CHANNEL UTILIZATION

A spectrum analyzer plots labeled "Channel UTILIZATION". The total number of channels is 79. The channels used have nominal center frequencies of 2403 through 2481 MHz. Three spectrum analyzer MAX HOLD plots labeled "BANDWIDTH" show the 20 dB bandwidth of the hopping channel to be < 1 MHz (.998 / .993 / 1.00 MHz) at the low/midband/high frequencies of 2.403/2.442/2.481 GHz. **Test Plots are shown in Appendix A.**

Zero span spectrum analyzer plot labeled "DWELL TIME" shows Worst case transmission time in a given slot: 40 msec dwell-time elapsed time, <100 %  
Maximum allowed: 400 msec.

**Test Data in Appendix A.**

### 6.1.2 15.247(b) MAXIMUM PEAK OUTPUT POWER

The three spectrum analyzer plots labeled " POWER OUT" show the maximum power of the hopping channel to be 24.3 dBm or 240 mW. The EUT was made to transmit uninterrupted random data on each of the low/mid/high channels. **Test Plots are shown in Appendix A.**

The output was taken from an N connector, through 3 feet of RG 142 cable, to Spectrum Analyzer set on Max Hold with no additional attenuation.

Power = 23.5 dBm (peak reading) +0.8dB cable loss = +24.3dBm / 240 mW EIRP

Limit: +30 dBm / 1 W maximum power

1. Decibel DB906S 8 dBi omni (tested as a pair with Radio Waves OMN-H-5-8 8, dBi OMNI as receiver antenna)
2. Decibel DB977H90 16 dBi 90° panel (tested as a pair with Radio Waves SEC-H-5-16-90, 16 dBi 90° sector, as receiver antenna)
3. Radio Waves SPI-2/5 14 dBi @ 2.4 GHz, Dual band 1' Parabolic
4. Radio Waves SP2-2/5 dual band 21 dBi @ 2.4 GHz 21 dBi 2' Parabolic

Decibel BB906S Omnidirectional Antenna  
EIRP= 24.3 (peak power) + 8 (peak gain) = 32.3 dBm/1.7W  
Limit 36 dBm/ 4 Watts

Decibel DB977H 90 Panel Antenna  
EIRP= 24.83 + 16 = 40.3 dBm/ 6.7W

Radio Waves SPI-2.5 1' Parabolic Directional Antenna  
EIRP= 24.3 + 14 = 38.3 dBm/ 6.7W

Radio Waves SP2-2/5 2' Parabolic Directional Antenna  
EIRP=24.3 + 21 = 45.3 dBm/ 33.8W

Note: Transient spikes that appear on Power Out plots are due to the hopping of the frequency synthesizer. The test software used does not key-off the transmitter when it hops. For this test, the transmitter was continuously hopping to the same channel, and transient occurred each time the synthesizer was reloaded.

In actual operation the frequency transients do not occur as the transmitter is turned back on after the synthesizer has had time to stabilize on the new channel frequency.

#### 6.1.3 **15.247(c) OUT OF BAND EMISSIONS**

The spectrum analyzer plots titled "" OUT OF BAND - BAND EDGES" shows the output spectrum of the EUT while hopping one of the pseudorandom sequences and continuously transmitting packetized data. The analyzer was placed in MAX HOLD mode, and individual sweeps were recorded continually for 10 minutes with the same spectrum analyzer connection as was used for peak output power. The resultant plot shows that the EUT emissions remain inside the 2400 - 2483.5 MHz band when measured in  $\geq 100$  kHz bandwidth during operation.

The spectrum analyzer plots labeled "OUT OF BAND <1GHz ", " OUT OF BAND 1 -2.75 GHz", and "OUT OF BAND 2.75 - 26.5 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 2400 - 2483.5 MHz band. **Test Plots are shown in Appendix A.**

#### 6.1.4 **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. See the WaveNet IP 2458 System description for justification of professional installation.

#### 6.1.5 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 groundplane 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 B** 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 = 1Mhz. Average measurements were made with a RBW = 1 MHz and a VBW = 10 Hz.

#### 6.1.6 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 C.**

#### 6.1.7 15.209 RADIATED EMISSIONS

with The attached table shows that the Class A radiated limits from 30 - 1000 MHz are not exceeded by the EUT. The EUT was operating normally a combination of transmission and reception and hopping one of the fifteen pseudorandom sequences 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 groundplane 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 is in Appendix D.**

Electronic Compliance Laboratories

Chris Byleckie

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Date  
Technical Director

**APPENDIX A**  
**SPREAD SPECTRUM PLOTS**

**The Plots For This Report Are In A Separate File**

**APPENDIX B**  
**RESTRICTED BAND DATA**

| <b>EUT:</b>             |         | WAVENET 2458               |       |      |       | <b>CUSTOMER NAME:</b> |      | WIRELESS |          |       |
|-------------------------|---------|----------------------------|-------|------|-------|-----------------------|------|----------|----------|-------|
| <b>RULE PART:</b>       |         | 15.247                     |       |      |       | <b>WORK ORDER:</b>    |      | 8092101  |          |       |
|                         |         |                            |       |      |       | <b>FILE:</b>          |      | 8092101A |          |       |
| <b>ANTENNA:</b>         |         | HORN                       |       |      |       | <b>ATTN dB</b>        |      | 0        |          |       |
| <b>POLARIZATION:</b>    |         | VERT                       |       |      |       | <b>DUTY dE</b>        |      | 0        |          |       |
| <b>MODULATION TYPE:</b> |         |                            |       |      |       | <b>HP IL dB</b>       |      | 0        |          |       |
| <b>TESTED BY:</b>       |         | SHAWN                      |       |      |       | <b>DIST dB:</b>       |      | 0        |          |       |
| <b>COMMENT:</b>         |         | DB977H90 14dBi DIR ANTENNA |       |      |       |                       |      |          |          |       |
| FREQ.                   | READING |                            | Pk    | A.F. | Cbl   | FLTR                  | AMP  | TOTAL,   | LIMIT    | DELTA |
| MHz                     | dB(uV)  | NF                         | or Av | dB   | dB    | dB                    | dB   | dB(uV/m) | dB(uV/m) | dB    |
| 2403                    |         |                            |       |      |       |                       |      |          |          |       |
| 4806.00                 | 45.00   |                            | Pk    | 31.4 | -7.0  | -0.4                  | 35.0 | 48.8     | 74.0     | -25.2 |
| 4806.00                 | 34.20   |                            | Avg   | 31.4 | -7.0  | -0.4                  | 35.0 | 38.0     | 54.0     | -16.0 |
| 7209.00                 | 47.00   | *                          | Pk    | 34.5 | -10.6 | -0.5                  | 35.5 | 57.1     | 74.0     | -16.9 |
| 7209.00                 | 31.00   | *                          | Avg   | 34.5 | -10.6 | -0.5                  | 35.5 | 41.1     | 54.0     | -12.9 |
| 96120.00                | 47.30   | *                          | Pk    | 36.8 | -13.0 | -0.5                  | 35.5 | 62.1     | 74.0     | -11.9 |
| 96120.00                | 25.80   | *                          | Avg   | 36.8 | -13.0 | -0.5                  | 35.5 | 40.6     | 54.0     | -13.4 |
| 12015.00                | 46.00   | *                          | Pk    | 39.0 | -13.6 | -0.5                  | 34.3 | 64.8     | 74.0     | -9.2  |
| 12015.00                | 27.00   | *                          | Avg   | 39.0 | -13.6 | -0.5                  | 34.3 | 45.8     | 54.0     | -8.2  |
| 14418.00                | 42.20   | *                          | Pk    | 41.8 | -14.5 | -0.5                  | 34.3 | 64.7     | 74.0     | -9.3  |
| 14418.00                | 25.20   | *                          | Avg   | 41.8 | -14.5 | -0.5                  | 34.3 | 47.7     | 54.0     | -6.3  |
| 16821.00                | 43.30   | *                          | Pk    | 38.8 | -16.8 | -0.5                  | 34.3 | 65.1     | 74.0     | -8.9  |
| 16821.00                | 26.20   | *                          | Avg   | 38.8 | -16.8 | -0.5                  | 34.3 | 48.0     | 54.0     | -6.0  |
| 2442                    |         |                            |       |      |       |                       |      |          |          |       |
| 4884.00                 | 45.30   |                            | Pk    | 31.4 | -7.0  | -0.4                  | 35.0 | 49.1     | 74.0     | -24.9 |
| 4884.00                 | 34.00   |                            | Avg   | 31.4 | -7.0  | -0.4                  | 35.0 | 37.8     | 54.0     | -16.2 |
| 7326.00                 | 46.10   | *                          | Pk    | 34.5 | -10.6 | -0.5                  | 35.4 | 56.3     | 74.0     | -17.7 |
| 7326.00                 | 32.80   | *                          | Avg   | 34.5 | -10.6 | -0.5                  | 35.4 | 43.0     | 54.0     | -11.0 |
| 97680.00                | 46.50   | *                          | Pk    | 36.8 | -13.0 | -0.5                  | 35.3 | 63.5     | 74.0     | -10.5 |
| 97680.00                | 25.30   | *                          | Avg   | 38.6 | -13.0 | -0.5                  | 35.3 | 48.0     | 54.0     | -6.0  |
| 12210.00                | 40.50   | *                          | Pk    | 39.0 | -13.6 | -0.5                  | 34.3 | 64.8     | 74.0     | -9.2  |
| 12210.00                | 23.30   | *                          | Avg   | 39.0 | -13.6 | -0.5                  | 34.3 | 45.8     | 54.0     | -8.2  |
| 14652.00                | 41.80   | *                          | Pk    | 41.9 | -15.5 | -0.5                  | 34.3 | 64.7     | 74.0     | -9.3  |
| 14652.00                | 23.50   | *                          | Avg   | 41.9 | -15.5 | -0.5                  | 34.3 | 47.7     | 54.0     | -6.3  |
| 17094.00                | 42.80   | *                          | Pk    | 41.9 | -16.9 | -0.5                  | 34.3 | 65.1     | 74.0     | -8.9  |
| 17094.00                | 24.20   | *                          | Avg   | 41.9 | -16.9 | -0.5                  | 34.3 | 48.0     | 54.0     | -6.0  |
| 2481                    |         |                            |       |      |       |                       |      |          |          |       |
| 4962.00                 | 49.00   | *                          | Pk    | 31.4 | -7.0  | -0.4                  | 35.0 | 52.8     | 74.0     | -21.2 |
| 4962.00                 | 34.20   | *                          | Avg   | 31.4 | -7.0  | -0.4                  | 35.0 | 38.0     | 54.0     | -16.0 |
| 7443.00                 | 48.70   | *                          | Pk    | 34.5 | -10.6 | -0.5                  | 35.4 | 58.9     | 74.0     | -15.1 |
| 7443.00                 | 34.30   | *                          | Avg   | 34.5 | -10.6 | -0.5                  | 35.4 | 44.5     | 54.0     | -9.5  |
| 9924.00                 | 48.70   | *                          | Pk    | 36.8 | -13.0 | -0.5                  | 35.5 | 63.5     | 74.0     | -10.5 |
| 9924.00                 | 33.20   | *                          | Avg   | 36.8 | -13.0 | -0.5                  | 35.5 | 48.0     | 54.0     | -6.0  |
| 12405.00                | 46.20   | *                          | Pk    | 39.0 | -13.6 | -0.5                  | 34.3 | 65.0     | 74.0     | -9.0  |
| 12405.00                | 30.00   | *                          | Avg   | 39.0 | -13.6 | -0.5                  | 34.3 | 48.8     | 54.0     | -5.2  |
| 14886.00                | 41.50   | *                          | Pk    | 41.9 | -15.5 | -0.5                  | 34.3 | 65.1     | 74.0     | -8.9  |
| 14886.00                | 26.20   | *                          | Avg   | 41.9 | -15.5 | -0.5                  | 34.3 | 49.8     | 54.0     | -4.2  |

|                  |         |                             |       |                |       |          |      |          |          |       |
|------------------|---------|-----------------------------|-------|----------------|-------|----------|------|----------|----------|-------|
| EUT:             |         | WAVENET 1P 2458             |       | CUSTOMER NAME: |       | WIRELESS |      |          |          |       |
| RULE PART:       |         | 15.247                      |       | WORK ORDER:    |       | 8092101  |      |          |          |       |
|                  |         |                             |       | FILE:          |       | 8092101B |      |          |          |       |
| ANTENNA:         |         | HORN                        |       | ATTN dB 0      |       |          |      |          |          |       |
| POLARIZATION:    |         | VERT                        |       | DUTY dB 0      |       |          |      |          |          |       |
| MODULATION TYPE: |         |                             |       | HP IL dB 0     |       |          |      |          |          |       |
| TESTED BY:       |         | SHAWN                       |       | DIST dB: 0     |       |          |      |          |          |       |
| COMMENT:         |         | DB906S.-T 6dBd OMNI ANTENNA |       |                |       |          |      |          |          |       |
| FREQ.            | READING |                             | Pk    | A.F.           | Cbl   | FLTR     | AMP  | TOTAL,   | LIMIT    | DELTA |
| MHz              | dB(uV)  | NF                          | or Av | dB             | dB    | dB       | dB   | dB(uV/m) | dB(uV/m) | dB    |
| 2403             |         |                             |       |                |       |          |      |          |          |       |
| 4806.00          | 46.00   |                             | Pk    | 31.4           | -7.0  | -0.4     | 35.0 | 49.8     | 74.0     | -24.2 |
| 4806.00          | 34.30   |                             | Avg   | 31.4           | -7.0  | -0.4     | 35.0 | 38.1     | 54.0     | -15.9 |
| 7209.00          | 47.00   | *                           | Pk    | 34.5           | -10.6 | -0.5     | 35.5 | 57.1     | 74.0     | -16.9 |
| 7209.00          | 26.50   | *                           | Avg   | 34.5           | -10.6 | -0.5     | 35.5 | 36.6     | 54.0     | -17.4 |
| 96120.00         | 46.50   | *                           | Pk    | 36.8           | -13.0 | -0.5     | 35.5 | 61.3     | 74.0     | -12.7 |
| 96120.00         | 26.40   | *                           | Avg   | 36.8           | -13.0 | -0.5     | 35.5 | 41.2     | 54.0     | -12.8 |
| 12015.00         | 45.30   | *                           | Pk    | 39.0           | -13.6 | -0.5     | 34.3 | 64.1     | 74.0     | -9.9  |
| 12015.00         | 26.10   | *                           | Avg   | 39.0           | -13.6 | -0.5     | 34.3 | 44.9     | 54.0     | -9.1  |
| 14418.00         | 42.00   | *                           | Pk    | 41.8           | -14.5 | -0.5     | 34.3 | 64.5     | 74.0     | -9.5  |
| 14418.00         | 25.30   | *                           | Avg   | 41.8           | -14.5 | -0.5     | 34.3 | 47.8     | 54.0     | -6.2  |
| 16821.00         | 42.60   | *                           | Pk    | 38.8           | -16.8 | -0.5     | 34.3 | 64.4     | 74.0     | -9.6  |
| 16821.00         | 25.80   | *                           | Avg   | 38.8           | -16.8 | -0.5     | 34.3 | 47.6     | 54.0     | -6.4  |
| 2442             |         |                             |       |                |       |          |      |          |          |       |
| 4884.00          | 46.30   |                             | Pk    | 31.4           | -7.0  | -0.4     | 35.0 | 50.1     | 74.0     | -23.9 |
| 4884.00          | 35.00   |                             | Avg   | 31.4           | -7.0  | -0.4     | 35.0 | 38.8     | 54.0     | -15.2 |
| 7326.00          | 46.30   | *                           | Pk    | 34.5           | -10.6 | -0.5     | 35.4 | 56.5     | 74.0     | -17.5 |
| 7326.00          | 31.80   | *                           | Avg   | 34.5           | -10.6 | -0.5     | 35.4 | 42.0     | 54.0     | -12.0 |
| 97680.00         | 45.90   | *                           | Pk    | 36.8           | -13.0 | -0.5     | 35.3 | 63.5     | 74.0     | -10.5 |
| 97680.00         | 26.00   | *                           | Avg   | 38.6           | -13.0 | -0.5     | 35.3 | 48.0     | 54.0     | -6.0  |
| 12210.00         | 41.20   | *                           | Pk    | 39.0           | -13.6 | -0.5     | 34.3 | 64.8     | 74.0     | -9.2  |
| 12210.00         | 24.00   | *                           | Avg   | 39.0           | -13.6 | -0.5     | 34.3 | 45.8     | 54.0     | -8.2  |
| 14652.00         | 42.00   | *                           | Pk    | 41.9           | -15.5 | -0.5     | 34.3 | 64.7     | 74.0     | -9.3  |
| 14652.00         | 23.40   | *                           | Avg   | 41.9           | -15.5 | -0.5     | 34.3 | 47.7     | 54.0     | -6.3  |
| 17094.00         | 42.40   | *                           | Pk    | 41.9           | -16.9 | -0.5     | 34.3 | 65.1     | 74.0     | -8.9  |
| 17094.00         | 23.60   | *                           | Avg   | 41.9           | -16.9 | -0.5     | 34.3 | 48.0     | 54.0     | -6.0  |
| 2481             |         |                             |       |                |       |          |      |          |          |       |
| 4962.00          | 48.20   |                             | Pk    | 31.4           | -7.0  | -0.4     | 35.0 | 52.0     | 74.0     | -22.0 |
| 4962.00          | 34.00   |                             | Avg   | 31.4           | -7.0  | -0.4     | 35.0 | 37.8     | 54.0     | -16.2 |
| 7443.00          | 48.20   | *                           | Pk    | 34.5           | -10.6 | -0.5     | 35.4 | 58.4     | 74.0     | -15.6 |
| 7443.00          | 33.90   | *                           | Avg   | 34.5           | -10.6 | -0.5     | 35.4 | 44.1     | 54.0     | -9.9  |
| 9924.00          | 47.20   | *                           | Pk    | 36.8           | -13.0 | -0.5     | 35.5 | 62.0     | 74.0     | -12.0 |
| 9924.00          | 33.00   | *                           | Avg   | 36.8           | -13.0 | -0.5     | 35.5 | 47.8     | 54.0     | -6.2  |
| 12405.00         | 45.80   | *                           | Pk    | 39.0           | -13.6 | -0.5     | 34.3 | 64.6     | 74.0     | -9.4  |
| 12405.00         | 29.10   | *                           | Avg   | 39.0           | -13.6 | -0.5     | 34.3 | 47.9     | 54.0     | -6.1  |
| 14886.00         | 41.50   | *                           | Pk    | 41.9           | -15.5 | -0.5     | 34.3 | 65.1     | 74.0     | -8.9  |
| 14886.00         | 24.00   | *                           | Avg   | 41.9           | -15.5 | -0.5     | 34.3 | 47.6     | 54.0     | -6.4  |

| EUT:             |         | WAVENET 2458 2.4GHZ |       |      |       |      | CUSTOMER NAME: |          | WIRELESS |       |
|------------------|---------|---------------------|-------|------|-------|------|----------------|----------|----------|-------|
| RULE PART:       |         | 15.247              |       |      |       |      | WORK ORDER:    |          | 8092101  |       |
|                  |         |                     |       |      |       |      | FILE:          |          | 8092101E |       |
| ANTENNA:         |         | HORN                |       |      |       |      | ATTN dB        |          | 0        |       |
| POLARIZATION:    |         | HORIZONTAL          |       |      |       |      | DUTY dB        |          | 0        |       |
| MODULATION TYPE: |         |                     |       |      |       |      | HP IL dB       |          | 0        |       |
| TESTED BY:       |         | SHAWN               |       |      |       |      | DIST dB:       |          | 0        |       |
| COMMENT:         |         | 2' DIA DISH ANTENNA |       |      |       |      |                |          |          |       |
| FREQ.            | READING |                     | Pk    | A.F. | Cbl   | FLTR | AMP            | TOTAL,   | LIMIT    | DELTA |
| MHz              | dB(uV)  | NF                  | or Av | dB   | dB    | dB   | dB             | dB(uV/m) | dB(uV/m) | dB    |
| 2403             |         |                     |       |      |       |      |                |          |          |       |
| 4806.00          | 46.20   | *                   | Pk    | 31.4 | -7.0  | -0.4 | 35.0           | 50.0     | 74.0     | -24.0 |
| 4806.00          | 27.80   | *                   | Avg   | 31.4 | -7.0  | -0.4 | 35.0           | 31.6     | 54.0     | -22.4 |
| 7209.00          | 48.50   | *                   | Pk    | 34.5 | -10.6 | -0.5 | 35.5           | 58.6     | 74.0     | -15.4 |
| 7209.00          | 27.83   | *                   | Avg   | 34.5 | -10.6 | -0.5 | 35.5           | 38.0     | 54.0     | -16.0 |
| 9612.00          | 46.50   | *                   | Pk    | 36.8 | -13.0 | -0.5 | 35.5           | 61.3     | 74.0     | -12.7 |
| 9612.00          | 27.10   | *                   | Avg   | 36.8 | -13.0 | -0.5 | 35.5           | 41.9     | 54.0     | -12.1 |
| 12015.00         | 46.20   | *                   | Pk    | 39.0 | -13.6 | -0.5 | 34.3           | 65.0     | 74.0     | -9.0  |
| 12015.00         | 26.30   | *                   | Avg   | 39.0 | -13.6 | -0.5 | 34.3           | 45.1     | 54.0     | -8.9  |
| 14418.00         | 43.30   | *                   | Pk    | 41.8 | -14.5 | -0.5 | 34.3           | 65.8     | 74.0     | -8.2  |
| 14418.00         | 25.70   | *                   | Avg   | 41.8 | -14.5 | -0.5 | 34.3           | 48.2     | 54.0     | -5.8  |
| 16821.00         | 42.00   | *                   | Pk    | 38.8 | -16.8 | -0.5 | 34.3           | 63.8     | 74.0     | -10.2 |
| 16821.00         | 24.00   | *                   | Avg   | 38.8 | -16.8 | -0.5 | 34.3           | 45.8     | 54.0     | -8.2  |
| 2433             |         |                     |       |      |       |      |                |          |          |       |
| 4866.00          | 46.20   | *                   | Pk    | 31.4 | -7.0  | -0.4 | 35.0           | 50.0     | 74.0     | -24.0 |
| 4866.00          | 26.30   | *                   | Avg   | 31.4 | -7.0  | -0.4 | 35.0           | 30.1     | 54.0     | -23.9 |
| 7299.00          | 47.00   | *                   | Pk    | 34.5 | -10.6 | -0.5 | 35.5           | 57.1     | 74.0     | -16.9 |
| 7299.00          | 27.30   | *                   | Avg   | 34.5 | -10.6 | -0.5 | 35.5           | 37.4     | 54.0     | -16.6 |
| 9732.00          | 46.20   | *                   | Pk    | 36.8 | -13.0 | -0.5 | 35.5           | 61.0     | 74.0     | -13.0 |
| 9848.00          | 26.80   | *                   | Avg   | 36.8 | -13.0 | -0.5 | 35.5           | 41.6     | 54.0     | -12.4 |
| 12310.00         | 45.80   | *                   | Pk    | 39.0 | -13.6 | -0.5 | 34.3           | 64.6     | 74.0     | -9.4  |
| 12165.00         | 25.90   | *                   | Avg   | 39.0 | -13.6 | -0.5 | 34.3           | 44.7     | 54.0     | -9.3  |
| 14598.00         | 43.10   | *                   | Pk    | 41.9 | -15.5 | -0.5 | 34.3           | 66.7     | 74.0     | -7.3  |
| 14598.00         | 23.50   | *                   | Avg   | 41.9 | -15.5 | -0.5 | 34.3           | 47.1     | 54.0     | -6.9  |
| 17031.00         | 44.00   | *                   | Pk    | 41.9 | -16.9 | -0.5 | 34.3           | 69.0     | 74.0     | -5.0  |
| 17031.00         | 24.10   | *                   | Avg   | 41.9 | -16.9 | -0.5 | 34.3           | 49.1     | 54.0     | -4.9  |
| 2481             |         |                     |       |      |       |      |                |          |          |       |
| 4962.00          | 46.30   | *                   | Pk    | 31.4 | -7.0  | -0.4 | 35.0           | 50.1     | 74.0     | -23.9 |
| 4962.00          | 27.00   | *                   | Avg   | 31.4 | -7.0  | -0.4 | 35.0           | 30.8     | 54.0     | -23.2 |
| 7443.00          | 47.00   | *                   | Pk    | 34.5 | -10.6 | -0.5 | 35.4           | 57.2     | 74.0     | -16.8 |
| 7443.00          | 26.30   | *                   | Avg   | 34.5 | -10.6 | -0.5 | 35.4           | 36.5     | 54.0     | -17.5 |
| 9924.00          | 45.20   | *                   | Pk    | 36.8 | -13.0 | -0.5 | 35.5           | 60.0     | 74.0     | -14.0 |
| 9924.00          | 26.00   | *                   | Avg   | 36.8 | -13.0 | -0.5 | 35.5           | 40.8     | 54.0     | -13.2 |
| 12405.00         | 44.30   | *                   | Pk    | 39.0 | -13.6 | -0.5 | 34.3           | 63.1     | 74.0     | -10.9 |
| 12405.00         | 24.60   | *                   | Avg   | 39.0 | -13.6 | -0.5 | 34.3           | 43.4     | 54.0     | -10.6 |
| 14886.00         | 43.10   | *                   | Pk    | 41.9 | -15.5 | -0.5 | 34.3           | 66.7     | 74.0     | -7.3  |
| 14886.00         | 24.00   | *                   | Avg   | 41.9 | -15.5 | -0.5 | 34.3           | 47.6     | 54.0     | -6.4  |

| EUT:             |         | WAVENET 2458 2.4GHZ |       |      |       |      | CUSTOMER NAME: |          | WIRELESS |       |
|------------------|---------|---------------------|-------|------|-------|------|----------------|----------|----------|-------|
| RULE PART:       |         | 15.247              |       |      |       |      | WORK ORDER:    |          | 8092101  |       |
|                  |         |                     |       |      |       |      | FILE:          |          | 9082101F |       |
| ANTENNA:         |         | HORN                |       |      |       |      | ATTN dB        |          | 0        |       |
| POLARIZATION:    |         | HORIZONTAL          |       |      |       |      | DUTY dE        |          | 0        |       |
| MODULATION TYPE: |         |                     |       |      |       |      | HP IL dB       |          | 0        |       |
| TESTED BY:       |         | SHAWN               |       |      |       |      | DIST dB:       |          | 0        |       |
| COMMENT:         |         | 1' DIA DISH ANTENNA |       |      |       |      |                |          |          |       |
| FREQ.            | READING |                     | Pk    | A.F. | Cbl   | FLTR | AMP            | TOTAL,   | LIMIT    | DELTA |
| MHz              | dB(uV)  | NF                  | or Av | dB   | dB    | dB   | dB             | dB(uV/m) | dB(uV/m) | dB    |
| 2403             |         |                     |       |      |       |      |                |          |          |       |
| 4806.00          | 46.30   | *                   | Pk    | 31.4 | -7.0  | -0.4 | 35.0           | 50.1     | 74.0     | -23.9 |
| 4806.00          | 27.80   | *                   | Avg   | 31.4 | -7.0  | -0.4 | 35.0           | 31.6     | 54.0     | -22.4 |
| 7209.00          | 47.00   | *                   | Pk    | 34.5 | -10.6 | -0.5 | 35.5           | 57.1     | 74.0     | -16.9 |
| 7209.00          | 26.30   | *                   | Avg   | 34.5 | -10.6 | -0.5 | 35.5           | 36.4     | 54.0     | -17.6 |
| 9612.00          | 46.20   | *                   | Pk    | 36.8 | -13.0 | -0.5 | 35.5           | 61.0     | 74.0     | -13.0 |
| 9612.00          | 27.10   | *                   | Avg   | 36.8 | -13.0 | -0.5 | 35.5           | 41.9     | 54.0     | -12.1 |
| 12015.00         | 46.20   | *                   | Pk    | 39.0 | -13.6 | -0.5 | 34.3           | 65.0     | 74.0     | -9.0  |
| 12015.00         | 25.80   | *                   | Avg   | 39.0 | -13.6 | -0.5 | 34.3           | 44.6     | 54.0     | -9.4  |
| 14418.00         | 43.10   | *                   | Pk    | 41.8 | -14.5 | -0.5 | 34.3           | 65.6     | 74.0     | -8.4  |
| 14418.00         | 25.00   | *                   | Avg   | 41.8 | -14.5 | -0.5 | 34.3           | 47.5     | 54.0     | -6.5  |
| 16821.00         | 42.00   | *                   | Pk    | 38.8 | -16.8 | -0.5 | 34.3           | 63.8     | 74.0     | -10.2 |
| 16821.00         | 23.40   | *                   | Avg   | 38.8 | -16.8 | -0.5 | 34.3           | 45.2     | 54.0     | -8.8  |
| 2433             |         |                     |       |      |       |      |                |          |          |       |
| 4866.00          | 46.40   | *                   | Pk    | 31.4 | -7.0  | -0.4 | 35.0           | 50.2     | 74.0     | -23.8 |
| 4866.00          | 26.80   | *                   | Avg   | 31.4 | -7.0  | -0.4 | 35.0           | 30.6     | 54.0     | -23.4 |
| 7299.00          | 47.30   | *                   | Pk    | 34.5 | -10.6 | -0.5 | 35.5           | 57.4     | 74.0     | -16.6 |
| 7299.00          | 27.00   | *                   | Avg   | 34.5 | -10.6 | -0.5 | 35.5           | 37.1     | 54.0     | -16.9 |
| 9732.00          | 46.20   | *                   | Pk    | 36.8 | -13.0 | -0.5 | 35.5           | 61.0     | 74.0     | -13.0 |
| 9848.00          | 26.00   | *                   | Avg   | 36.8 | -13.0 | -0.5 | 35.5           | 40.8     | 54.0     | -13.2 |
| 12310.00         | 44.90   | *                   | Pk    | 39.0 | -13.6 | -0.5 | 34.3           | 63.7     | 74.0     | -10.3 |
| 12165.00         | 24.00   | *                   | Avg   | 39.0 | -13.6 | -0.5 | 34.3           | 42.8     | 54.0     | -11.2 |
| 14598.00         | 43.40   | *                   | Pk    | 41.9 | -15.5 | -0.5 | 34.3           | 67.0     | 74.0     | -7.0  |
| 14598.00         | 23.50   | *                   | Avg   | 41.9 | -15.5 | -0.5 | 34.3           | 47.1     | 54.0     | -6.9  |
| 17031.00         | 43.60   | *                   | Pk    | 41.9 | -16.9 | -0.5 | 34.3           | 68.6     | 74.0     | -5.4  |
| 17031.00         | 23.80   | *                   | Avg   | 41.9 | -16.9 | -0.5 | 34.3           | 48.8     | 54.0     | -5.2  |
| 2481             |         |                     |       |      |       |      |                |          |          |       |
| 4962.00          | 46.80   | *                   | Pk    | 31.4 | -7.0  | -0.4 | 35.0           | 50.6     | 74.0     | -23.4 |
| 4962.00          | 27.50   | *                   | Avg   | 31.4 | -7.0  | -0.4 | 35.0           | 31.3     | 54.0     | -22.7 |
| 7443.00          | 46.80   | *                   | Pk    | 34.5 | -10.6 | -0.5 | 35.4           | 57.0     | 74.0     | -17.0 |
| 7443.00          | 26.30   | *                   | Avg   | 34.5 | -10.6 | -0.5 | 35.4           | 36.5     | 54.0     | -17.5 |
| 9924.00          | 45.20   | *                   | Pk    | 36.8 | -13.0 | -0.5 | 35.5           | 60.0     | 74.0     | -14.0 |
| 9924.00          | 25.40   | *                   | Avg   | 36.8 | -13.0 | -0.5 | 35.5           | 40.2     | 54.0     | -13.8 |
| 12405.00         | 44.60   | *                   | Pk    | 39.0 | -13.6 | -0.5 | 34.3           | 63.4     | 74.0     | -10.6 |
| 12405.00         | 24.30   | *                   | Avg   | 39.0 | -13.6 | -0.5 | 34.3           | 43.1     | 54.0     | -10.9 |
| 14886.00         | 43.10   | *                   | Pk    | 41.9 | -15.5 | -0.5 | 34.3           | 66.7     | 74.0     | -7.3  |
| 14886.00         | 23.60   | *                   | Avg   | 41.9 | -15.5 | -0.5 | 34.3           | 47.2     | 54.0     | -6.8  |

**APPENDIX C**  
**15.207**  
**CONDUCTED EMISSIONS**

Electronic Compliance Laboratories, Inc.  
1249 Birchwood Ave.  
Sunnyvale, CA

Conducted Emissions  
Frequency range: 450KHz-30MHz

Government Agency and Limit: FCC Class A  
-----

QP = Quasi-Peak    Note: Ignore peak readings when Quasi-Peak reading exists

PK = Peak

Customer:                      WIRELESS                      Operator:                      SHAWN  
Date:                            10-16-1998                      Time:                            12:21:57  
Temperature Range:    72                      Deg F                      Percent Humidity: 45  
E.U.T.:                          WAVENET IP 2458 2.4 Ghz UNIT  
Serial Number:                PROTO  
Support Devices:  
Serial Number:  
FCC ID:  
Exercise Program:  
Modifications:                None  
Report File Name:              F:\TESTDATA\8092101B.F

| TEST<br>FREQ<br>===== | TEST<br>dBuV<br>===== | CLASS A<br>LIMIT<br>===== | VERSUS<br>A LIMIT<br>===== | CONDUCTOR<br>===== | TYPE<br>===== |
|-----------------------|-----------------------|---------------------------|----------------------------|--------------------|---------------|
| 0.890                 | 27.1                  | 60.0                      | -32.9                      | NEUTRAL            | PK            |
| 5.770                 | 23.1                  | 69.5                      | -46.4                      | NEUTRAL            | PK            |
| 10.280                | 26.6                  | 69.5                      | -42.9                      | NEUTRAL            | PK            |
| 16.330                | 26.5                  | 69.5                      | -43.0                      | NEUTRAL            | PK            |
| 29.480                | 14.1                  | 69.5                      | -55.4                      | NEUTRAL            | PK            |
| 0.670                 | 22.8                  | 60.0                      | -37.2                      | LINE               | PK            |
| 6.580                 | 19.4                  | 69.5                      | -50.1                      | LINE               | PK            |
| 10.420                | 25.0                  | 69.5                      | -44.5                      | LINE               | PK            |
| 16.630                | 25.8                  | 69.5                      | -43.7                      | LINE               | PK            |
| 28.970                | 13.9                  | 69.5                      | -55.6                      | LINE               | PK            |



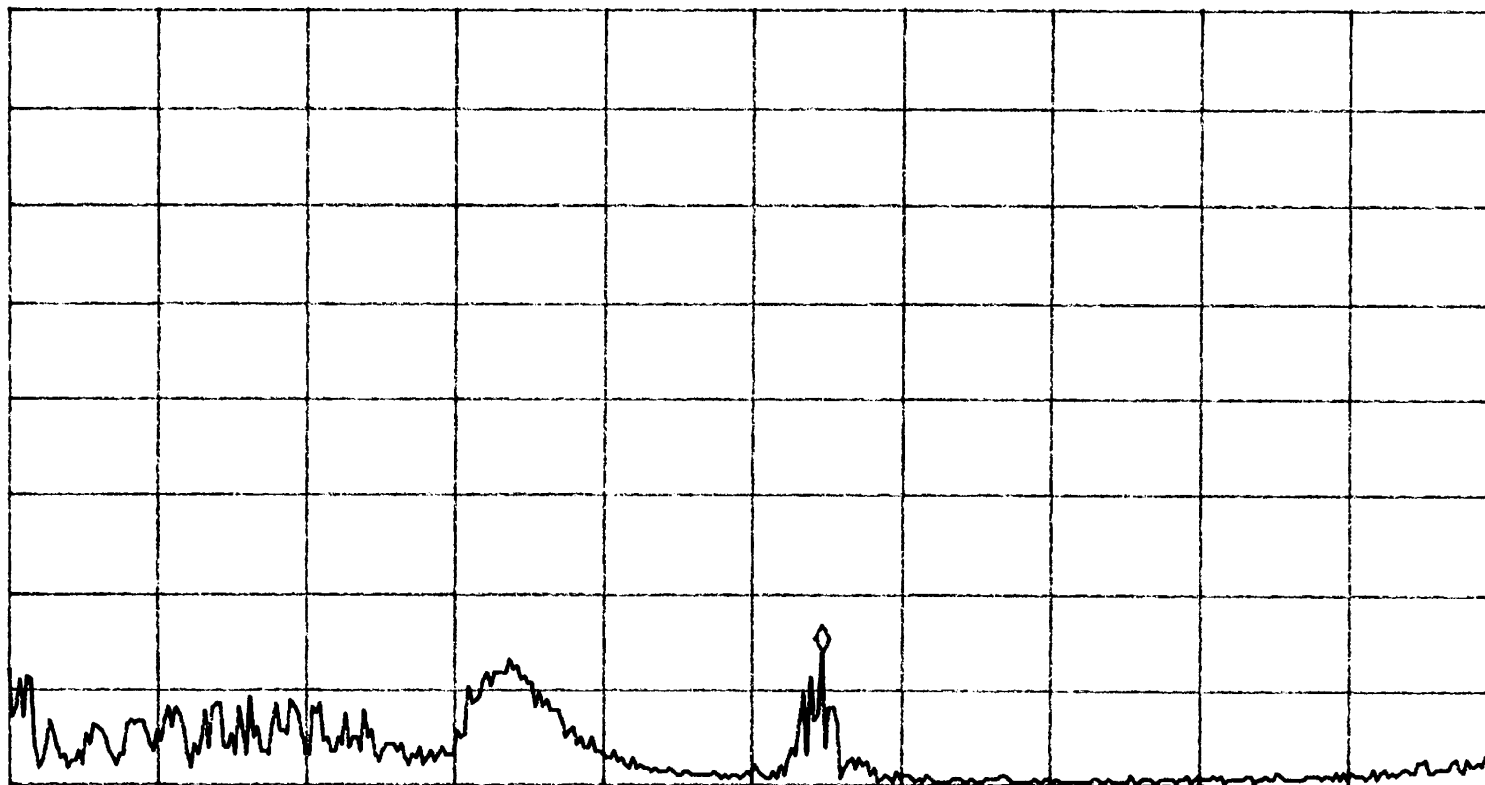
(7D) 12:09:39 OCT 16, 1998  
8092101B LINE 2.4GHz UNIT

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 16.63 MHz  
25.75 dB $\mu$ V

LOG REF 92.0 dB $\mu$ V

10  
dB/  
ATN  
10 dB

MA SB  
SC FS  
ACORR



START 450 kHz

IF BW 9.0 kHz

AVG BW 30 kHz

STOP 30.00 MHz

SWP 2.46 sec

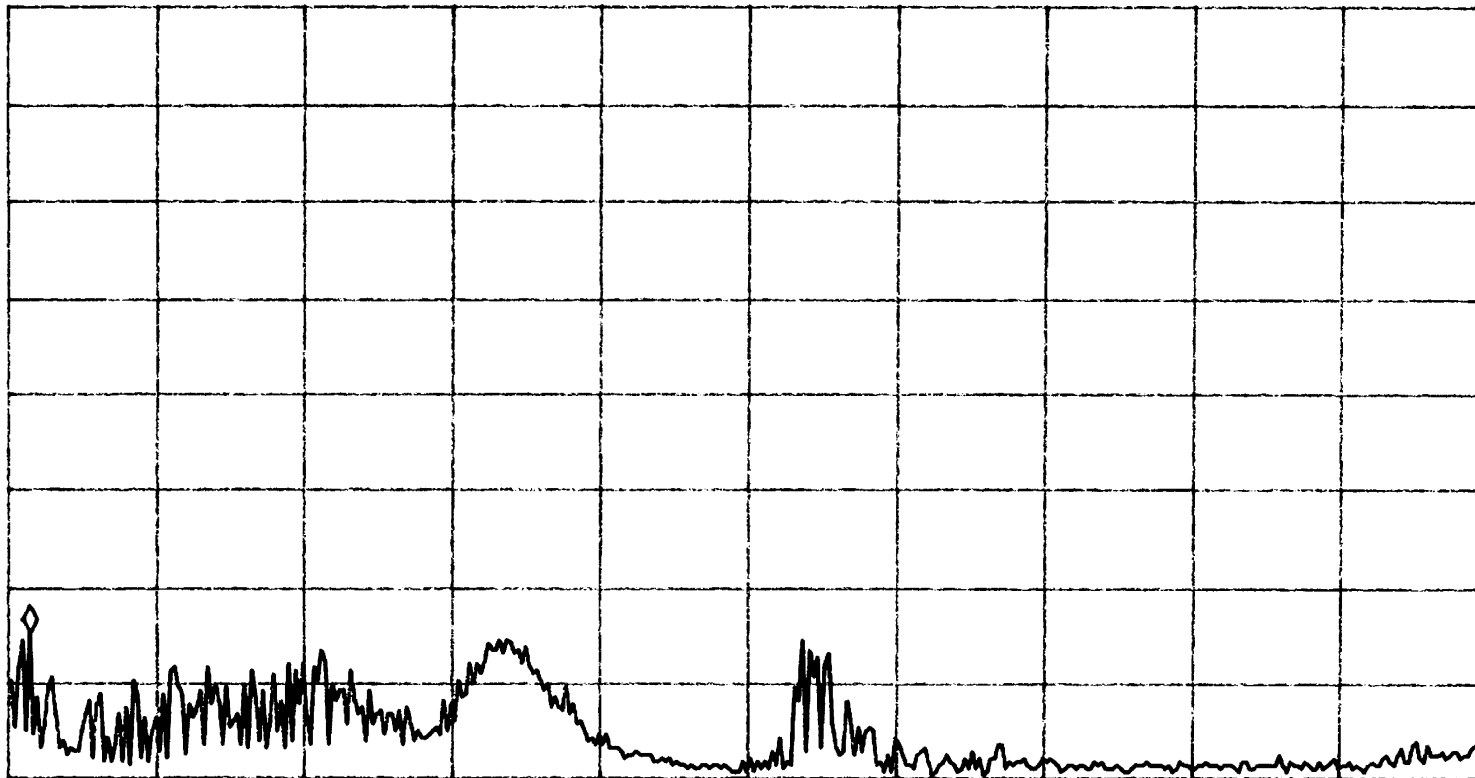
12:05:36 OCT 16, 1998  
8092101B NEUTRAL 2.4GHz UNIT

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 890 kHz  
27.11 dB $\mu$ V

LOG REF 92.0 dB $\mu$ V

10  
dB/  
ATN  
10 dB

MA SB  
SC FS  
ACORR



START 450 kHz

IF BW 9.0 kHz

AVG BW 30 kHz

STOP 30.00 MHz

SWP 2.46 sec



**APPENDIX D**  
**15.209**  
**RADIATED EMISSIONS**

Electronic Compliance Laboratories, Inc.  
 1249 Birchwood Ave.  
 Sunnyvale, CA  
 Radiated Emissions  
 Frequency range: 30MHz-1000MHz  
 10 Meter Open Site  
 Site Calibrated: June 1997

Government Agency and Limit: FCC Class A  
 -----

QP = Quasi-Peak      Note: Ignore peak readings when Quasi-Peak reading exists  
 PK = Peak

Customer:                      WIRELESS                      Operator:                      SHAWN  
 Date:                          09-21-1998                      Time:                          14:34:24  
 Temperature Range:      78                      Deg F                      Percent Humidity: 50  
 E.U.T.:                      WAVENET IP2458 MODIFIED BOX  
 Serial Number:  
 Support Devices:  
 Serial Number:  
 FCC ID:  
 Exercise Program:  
 Modifications:              None  
 Report File Name:          F:\TESTDATA\8092101A.RF

Antenna Type:              BICONICAL

| TEST<br>FREQ | TEST<br>dBuV | ACTUAL<br>dBuV/m | CLASS A<br>LIMIT | VERSUS<br>A LIMIT | TABLE<br>DEGREES | ANTENNA<br>HEIGHT | POLAR-<br>IZATION | DETECTOR<br>Type |
|--------------|--------------|------------------|------------------|-------------------|------------------|-------------------|-------------------|------------------|
| =====        | =====        | =====            | =====            | =====             | =====            | =====             | =====             | =====            |
| 38.750       | 37.2         | 26.3             | 39.0             | -12.7             | 270              | 1.5               | V                 | PK               |
| 43.200       | 46.1         | 33.7             | 39.0             | -5.3              | 180              | 2.0               | V                 | PK               |
| 43.200       | 44.5         | 32.1             | 39.0             | -6.9              | 180              | 2.0               | V                 | QP               |
| 132.04       | 39.0         | 29.3             | 43.5             | -14.2             | 150              | 2.0               | V                 | PK               |
| 132.600      | 38.4         | 28.8             | 43.5             | -14.7             | 150              | 2.0               | H                 | PK               |
| 42.925       | 41.5         | 29.1             | 39.0             | -9.9              | 200              | 2.0               | H                 | PK               |

NOTE: NO OTHER EMISSIONS TO 1 Ghz

+-----+

**APPENDIX E**  
**SET-UP PHOTOS**



**FCC 15.209 Class B  
Radiated Emissions**



**FCC 15.205 Restricted Band**



**FCC 15.205 Restricted Band**



**FCC 15.205 Restricted Band**





**FCC 15.247 Conducted RF**