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## **FCC Certification Test Report**

**Manufacturer: RELM Wireless Corporation**

**Model: RPU16A**

**FCC ID: ARURPU416A**

**Rule Parts: 22**

**74**

**80**

**90**

**Test Begin Date: March 7, 2002**

**Test End Date: March 14, 2002**

**Report Issue Date: March 27, 2002**

**Test Result: PASS**

**Prepared by: R. Sam Wismer Engineering Manager**

|                                             |
|---------------------------------------------|
| <b>THIS REPORT CONTAINS <u>14</u> PAGES</b> |
|---------------------------------------------|



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## 1.0 GENERAL

### 1.1 Introduction

The purpose of this report is to demonstrate compliance with the relevant sections of parts 22, 74, 80 and 90 of the FCC's Code of Federal Regulations.

### 1.2 Product Description

#### 1.2.1 General

The Equipment Under Test (EUT), is the Model RPU16A. The RPU416A is a two way audio communication radio device manufactured by RELM Wireless Corporation. RELM Wireless is located at the following address:

RELM Wireless Corporation  
7100 Technology Drive  
W. Melbourne, FL. 32904

Detailed Photographs of the EUT are included separately in this filing.

#### 1.2.2 Intended Use

The EUT is intended to be used in any environment where two way communication is required.

#### 1.2.3 Technical Specifications

**Table 1.2.3-1: Specifications**

|                    |                              |
|--------------------|------------------------------|
| Frequency Band     | 450 – 470MHz                 |
| Number of Channels | 16                           |
| Channel Bandwidth  |                              |
| Channel Spacing    | Capable of 12.5Khz and 25kHz |
| Output power       | 4 Watts Nominal              |

## 2.0 TEST FACILITY

### 2.1 Location

RELM Wireless Corporation performed the majority of the testing. ACS Inc. performed the radiated spurious emissions test only, located at the following address:

Advanced Compliance Solutions  
5015 B.U. Bowman Drive  
Buford, GA 30518  
Phone: (770) 831-8048  
Fax: (770) 831-8598

Radiated spurious emissions were performed on an open area test site operated by ACS, Inc. The site have been fully described, submitted to, and accepted by the FCC and Industry Canada. FCC registration number 89450 and Industry Canada Lab Code IC 4175 have been assigned in recognition of the site. The site is also in conformance with publication CISPR16.

## 2.2 Radiated Emission Site Description

An open area test site(OATS) was used for measuring the radiated spurious emissions. The OATS was constructed in accordance with ANSI C63.4 and consists of a 40' x 66' concrete pad covered with perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane, however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 3.2-1 below:

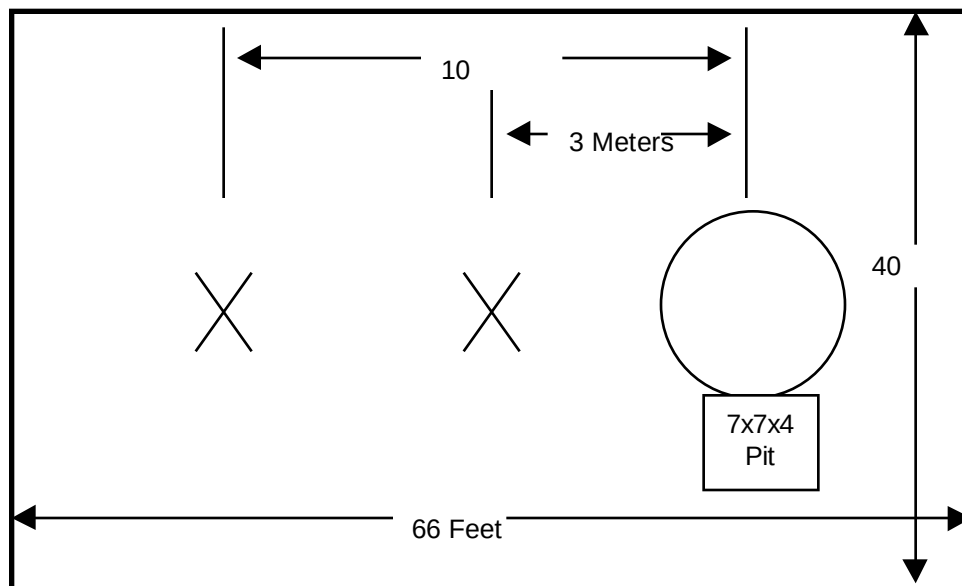


Figure 2.2-1: Open Area Test Site

### 3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- 1 - ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- 2 - US Code of Federal Regulations (CFR): Title 47, Part 2
- 3 - US Code of Federal Regulations (CFR): Title 47, Part 22
- 4 - US Code of Federal Regulations (CFR): Title 47, Part 74
- 5 - US Code of Federal Regulations (CFR): Title 47, Part 80
- 6 - US Code of Federal Regulations (CFR): Title 47, Part 90
- 7 – TIA/EIA 603
- 8 - FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

### 4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturers specifications.

**Table 4-1: Test Equipment**

| MFG Name              | Item Name:              | Model #: | Serial #   | Recal Date: |
|-----------------------|-------------------------|----------|------------|-------------|
| Rohde & Schwarz       | Spectrum Analyzer       | ESMI-RF  | 839587/003 | 8/10/02     |
| Rohde & Schwarz       | Display Unit            | ESAI-D   | 839379/011 | 8/10/02     |
| Chase                 | Bi-Log                  | CBL6111  | 1043       | 10/23/02    |
| Spectrum Technologies | Horn Antenna            | DRH-0118 | 970102     | 9/9/02      |
| Hewlett Packard       | Spectrum Analyzer       | 8561A    |            | 8/24/02     |
| Hewlett Packard       | Communications Analyzer | 8920A    |            | 4/02/02*    |
| Hewlett Packard       | Modulation Analyzer     | 8901A    |            | 4/11/02     |
| Hewlett Packard       | Audio Analyzer          | 8903B    |            | 6/22/02     |
| LeCroy                | Digital Oscilloscope    | LC334A   |            | 6/21/02     |

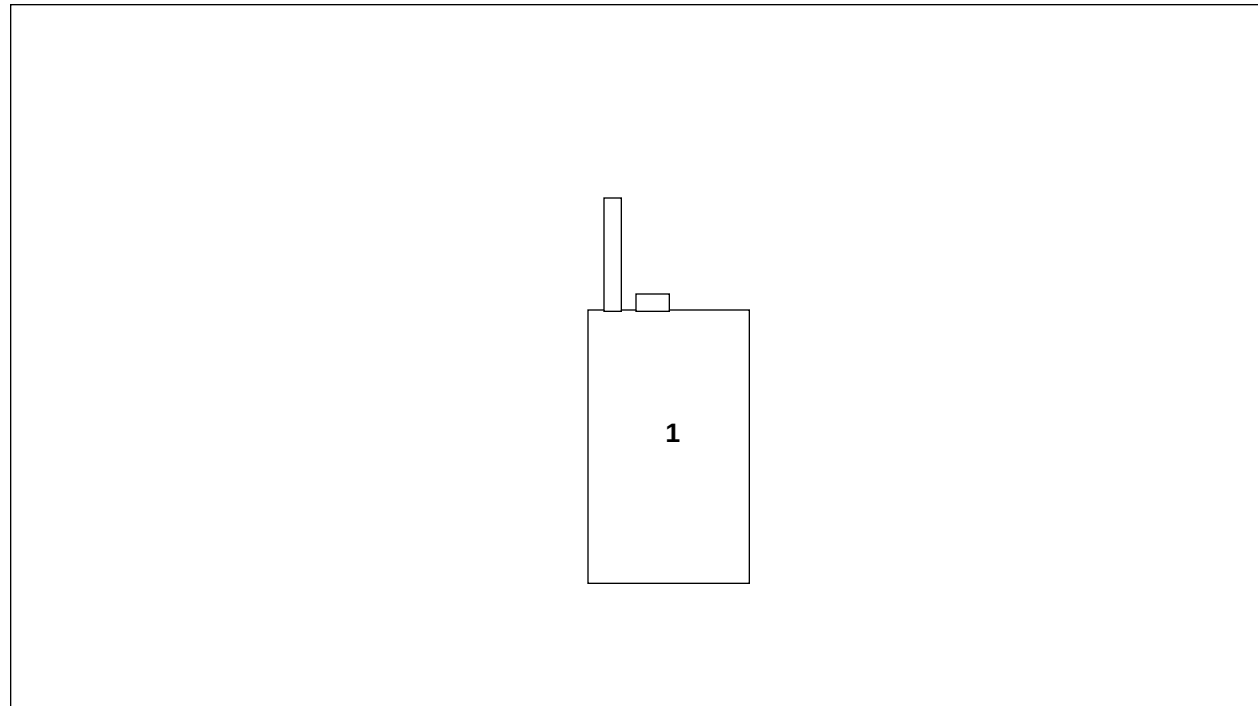
\*Equipment was in calibration at the time of testing

### 5.0 SUPPORT EQUIPMENT

Table 5-3: Support Equipment

| Manufacturer | Equipment Type         | Model Number | Serial Number | FCC ID |
|--------------|------------------------|--------------|---------------|--------|
|              |                        |              |               |        |
|              | EUT is self supporting |              |               |        |
|              |                        |              |               |        |
|              |                        |              |               |        |

## 6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



M = Meters

S = Shielded

U = Unshielded

Figure 6-1: EUT Test Setup

## 7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

### 7.1 RECEIVER CHARACTERISTICS

#### 7.1.1 Conducted Spurious Emissions

| Freq.(MHz.) | Spur(dBm) |
|-------------|-----------|
| 450.05      | -83.6     |
| 460.5       | -85       |
| 469.95      | -90       |

#### 7.1.2 Reference Sensitivity

| Freq.(Mhz) | Wide Sens(uV) | Narrow Sens(uV) |
|------------|---------------|-----------------|
| 450.05     | 0.226         | 0.260           |
| 460.5      | 0.219         | 0.245           |
| 469.95     | 0.211         | 0.240           |

### 7.1.3 RF Quieting

|          | Wide (uV) | Narrow (uV) |
|----------|-----------|-------------|
| RF Level | 0.278     | 0.298       |

### 7.1.4 Signal Displacement Bandwidth

| Freq.(Mhz) | Wide (KHz) | Narrow (KHz) |
|------------|------------|--------------|
| 469.95     | 3.8        | 5            |

### 7.1.5 Adjacent Channel Rejection

| Freq.(MHz) | Wide Band |          | Narrow Band |          |
|------------|-----------|----------|-------------|----------|
|            | Low(dB)   | High(dB) | Low(dB)     | High(dB) |
| 450.05     | 74.6      | 75.3     | 63.7        | 65.6     |
| 460.5      | 74        | 74.6     | 63.6        | 64.8     |
| 469.95     | 73.5      | 73.7     | 62.9        | 63.9     |

### 7.1.6 Spurious Response Rejection

| First Image |               |                 |
|-------------|---------------|-----------------|
| Freq.(MHz)  | Wide Band(dB) | Narrow Band(dB) |
| 450.05      | 84            | 83.1            |
| 460.5       | 84.4          | 82.5            |
| 469.95      | 84.1          | 82              |

| Second Image |               |                 |
|--------------|---------------|-----------------|
| Freq.(MHz)   | Wide Band(dB) | Narrow Band(dB) |
| 450.05       | 96.1          | 95.7            |
| 460.5        | 96.2          | 95.5            |
| 469.95       | 96.3          | 95.3            |

| Half Image(1st IF) |
|--------------------|
|--------------------|

| Freq.(MHz) | Wide Band(dB) | Narrow Band(dB) |
|------------|---------------|-----------------|
| 450.05     | 93.4          | 92              |
| 460.5      | 84.2          | 82.3            |
| 469.95     | 79.2          | 77.5            |

Note: 1st IF=38.85 MHz  
2nd IF=455KHz

#### 7.1.7 Inter-modulation Rejection @ 50kHz Offset

| Freq (MHz) | Wide Band |          | Narrow Band |          |
|------------|-----------|----------|-------------|----------|
|            | Low(dB)   | High(dB) | Low(dB)     | High(dB) |
| 450.05     | 65.4      | 65.9     | 64.1        | 64.6     |
| 460.5      | 64.8      | 65.2     | 63.5        | 63.8     |
| 469.95     | 64.0      | 64.6     | 62.9        | 63.4     |

#### 7.1.8 Audio Frequency Response

See Appendix A for Audio Frequency Response curves

#### 7.1.9 Hum and Noise Ratio

| Freq.(Mhz) |              | Wide(dB) | Narrow(dB) |
|------------|--------------|----------|------------|
| 469.95     | Un-squelched | 54.7     | 48.75      |
|            | Squelched    | -86dbw   | -86dbw     |

#### 7.1.10 Audio Distortion

| Freq.(Mhz) |         | Wide(%) | Narrow(%) |
|------------|---------|---------|-----------|
| 469.95     | @ rated | 1.80%   | 1.80%     |
|            | @ -17db | 1.20%   | 1.20%     |

#### 7.1.11 Audio Squelch Sensitivity

|           | Wide (dB)           | Narrow (dB)         |
|-----------|---------------------|---------------------|
| Threshold | -123.4dbm/6.2dbsin  | -124dbm/3.6dbsin    |
| Tight     | -116.9dbm/21.5dbsin | -117.2dbm/15.6dbsin |

#### 7.1.12 Squelch Blocking

| Wide | Narrow |
|------|--------|
| pass | pass   |

### 7.1.13 Receiver Attack Time

The receiver attack time was measured to be: **24mS**

### 7.1.14 Receiver Closing Time

The receiver closing time was measured to be: **46mS**

### 7.1.15 Audio Sensitivity

| Wide (KHz) | Narrow (KHz) |
|------------|--------------|
| 0.59       | 0.36         |

### 7.1.16 Current Drain Under Standard Test Conditions

| Current Drain @ Rated Audio |                     | 255 ma |
|-----------------------------|---------------------|--------|
|                             | Standby/Batt. Saver |        |
| 450.05                      | 61.4/5.88 ma        |        |
| 460.5                       | 61.2/5.72 ma        |        |
| 469.95                      | 61.3/6.08 ma        |        |

Note: 80% batt saver on and  
20% standby

## 7.2 TRANSMITTER CHARACTERISTICS

### 7.2.1 RF Output Power

| Freq.(MHz) | Wide<br>(Watts/Amps) |
|------------|----------------------|
| 450.05     | 4.12/1.46            |
| 460.5      | 4.43/1.44            |
| 469.95     | 4.36/1.42            |

### 7.2.2 Frequency Stability

| Temperature<br>(C.) | Frequency Error<br>(PPM) |
|---------------------|--------------------------|
| 60                  | 0.074                    |
| 50                  | -0.017                   |
| 40                  | -0.095                   |
| 30                  | 0.000                    |
| 25                  | 0.076                    |

|     |       |
|-----|-------|
| 20  | 0.200 |
| 10  | 0.625 |
| 0   | 1.020 |
| -10 | 1.490 |
| -20 | 1.620 |
| -30 | 1.440 |

### 7.2.3 Modulation Limiting

See Appendix B for Modulation Limiting Response Curves

### 7.2.4 Carrier Attack Time

The carrier attack time was measured to be: **68mS**

### 7.2.5 Audio Sensitivity

| Freq. (MHz) | Wide (mvRms) | Narrow (mvRms) |
|-------------|--------------|----------------|
| 450.05      | 11.9         | 11.5           |
| 460.5       | 12.6         | 12.2           |
| 469.95      | 12.2         | 12.1           |

### 7.2.6 Audio Frequency Response

See Appendix C and D for Audio Frequency Response Curves

### 7.2.7 Audio Distortion

|            | Wide (%) | Narrow (%) |
|------------|----------|------------|
| Distortion | 0.60%    | 1.00%      |

### 7.2.8 FM Hum and Noise Ratio

| Freq. (MHz) | Wide (dB) | Narrow (dB) |
|-------------|-----------|-------------|
| 450.05      | 49.6      | 44.7        |
| 460.5       | 52.3      | 48.4        |
| 469.95      | 52.7      | 50.7        |

### 7.2.9 AM Hum and Noise Ratio

|     | Wide (dB) | Narrow (dB) |
|-----|-----------|-------------|
| H/N | 32.7      | 33.5        |

### 7.2.10 Sideband Spectrum/Emission Mask

See Appendix E for Sideband Spectrum/Emission Mask Curves

#### 7.2.11 Conducted Spurious Emissions

See Appendix F for Conducted Spurious Data

#### 7.2.12 Transient Frequency Behavior

See Appendix G for Transient Behavior Curves

#### 7.2.13 Audio Low Pass Filter Frequency Response

See Appendix H for Audio Low Pass Filter Response Curves

#### 7.2.14 Deviation Symmetry

See Appendix I for Deviation Symmetry Data

#### 7.2.15 Deviation Variation

See Appendix J for Deviation Variation Data

#### 7.2.16 Frequency Stability vs. Voltage

| Supply | Freq. Error (PPM) |
|--------|-------------------|
| 6.0    | -0.162            |
| 6.5    | -0.169            |
| 7.0    | -0.156            |
| 7.5    | -0.152            |
| 8.0    | -0.162            |
| 8.5    | -0.175            |
| 9.0    | -0.179            |

#### 7.2.17 Radiated Spurious Emissions

See Appendix K and L for Radiated Spurious Emissions Data and Graphs

### 7.3 SUBAUDIBLE SIGNALLING CHARACTERISTICS

#### 7.3.1 Squelch Opening SINAD

|       | Wide (dB)          | Narrow (dB)      |
|-------|--------------------|------------------|
| 460.5 | -122.1dbm/8.2dbsin | -122dbm/6.0dbsin |

#### 7.3.2 Transmitter Modulation Limiting

|         | + Peak     |              | - Peak     |              |
|---------|------------|--------------|------------|--------------|
| 450.03  | Wide (KHz) | Narrow (KHz) | Wide (KHz) | Narrow (KHz) |
| Instant | 4.875      | 2.64         | 4.886      | 2.66         |
| Steady  | 4.83       | 2.42         | 4.75       | 2.43         |
| Highest | 5.3        | 2.68         | 5.11       | 2.66         |
|         |            |              |            |              |
| 460.5   | Wide (KHz) | Narrow (KHz) | Wide (KHz) | Narrow (KHz) |
| Instant | 4.7        | 2.43         | 4.54       | 2.725        |
| Steady  | 4.54       | 2.32         | 4.5        | 2.38         |
| Highest | 4.996      | 2.58         | 4.85       | 2.65         |
|         |            |              |            |              |
| 469.95  | Wide (KHz) | Narrow (KHz) | Wide (KHz) | Narrow (KHz) |
| Instant | 5.31       | 3.3          | 5.08       | 3.48         |
| Steady  | 4.69       | 2.38         | 4.66       | 2.44         |
| Highest | 5.27       | 2.68         | 5.06       | 2.76         |

### 7.3.3 CTCSS Tone Distortion

|               | Wide | Narrow |
|---------------|------|--------|
| Distortion(%) | 0.9% | 1.2%   |

### 7.3.4 Transmitter SINAD

|       | Wide(dB) | Narrow(dB) |
|-------|----------|------------|
| SINAD | 42.0     | 39.8       |

### 7.3.5 CDCSS Waveform Distortion

The CDCSS waveform distortion was measured to be: **12.5%**

### 7.3.6 Transmitter Hum and Noise Ratio

|     | Wide(dB) | Narrow(dB) |
|-----|----------|------------|
| H/N | 52.0     | 45.8       |

### 7.3.7 Transmitter Sub-audible Deviation

| Freq(MHz) | Wide(Hz) | Narrow(Hz) |
|-----------|----------|------------|
| 450.05    | 657      | 479        |
| 460.5     | 689      | 491        |
| 469.95    | 700      | 500        |

## 8.0 RF SAFETY

The EUT is considered portable equipment and is subject to SAR requirements. A SAR evaluation was performed on the EUT and the results were satisfactory. The SAR report is included in this filing separately.

#### **9.0 CONCLUSION**

The EUT meets the applicable requirements of Parts 22, 74, 80 and 90.