

**TEST REPORT #211103**

**STANDARD: FCC PART 15**

**SUBPART C--INTENTIONAL RADIATORS**

**SECTION 15. 231 PERIODIC OPERATION  
IN THE BAND  
40.66-40.70 MHZ AND ABOVE 70 MHZ**

**EQUIPMENT TESTED:**

**LARCO DIVISION OF ACROMETAL**

**MODEL: ULTRASMALL TRANSMITTER**

**TEST DATE: 21 NOVEMBER 2003**

1100 Falcon Avenue  
Glencoe, MN 55336



Tele: 320-864-4444  
Fax: 320-864-6611

**Prepared for:**

Larco Division of Acrometal  
1902 13<sup>th</sup> Street SE  
Brainerd, MN 56401

**Test agent:**

International Certification Services, Inc.  
1100 Falcon Avenue  
Glencoe, MN 55336  
Tele: 320-864-4444  
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**Test location:**

International Certification Services, Inc.  
1100 Falcon Avenue  
Glencoe, MN 55336  
Tele: 320-864-4444  
Fax: 320-864-6611

**Prepared by:**

International Certification Services, Inc.  
1100 Falcon Avenue  
Glencoe, MN 55336

International Certification Services represents to the client that testing is done in accordance with standard procedures applicable and that reported test results are accurate within generally accepted commercial ranges of accuracy.

This report only applies to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. International Certification Services shall have no liability for any deductions, inferences or generalizations drawn by the client or others from this report.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval.

## **1.0 TEST SUMMARY**

**TEST REPORT:** #211103

**COMPANY:** Larco Division of Acrometal

**AGENT:** International Certification Services, Inc.

**PHONE:** 320-864-4444

**TEST DATE:** 21 November, 2003

**EQUIPMENT UNDER TEST:** Ultra Small Transmitter (433.92 Mhz)

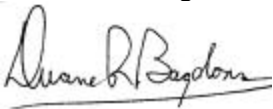
**GENERAL TEST SUMMARY:** The testing was performed at International Certification Services, Inc. at 1100 Falcon Ave, Glencoe, MN 55336

**VERIFICATION / CERTIFICATION STATUS:** The Larco Division of Acrometal, Model: Ultra Small Transmitter (433.92 Mhz) was found to be in compliance with the FCC Part 15 Subpart C, Section 15.231 requirements.

**MODIFICATIONS NECESSARY:** None

### **TESTED AND WRITTEN BY**

Duane R. Bagdons



## Applicable Standards

47 CFR Ch.1 (10-1-98 Edition)

FCC Part 15 Radio Frequency Devices

Subpart C Intentional Radiators

Section 15.231 Periodic operation in the band 40.66-40.70 Mhz and above 70 Mhz.

## 2.1 Referenced Standards

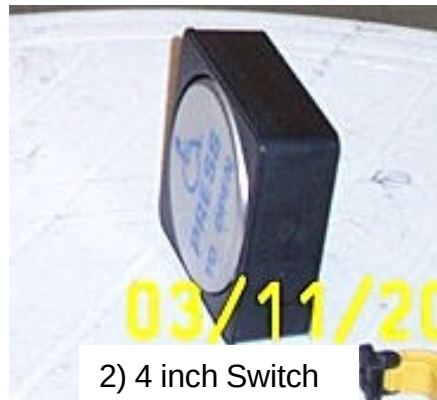
ANSI C63.4-2000 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 Ghz.

## 2.2 Equipment Units Tested

The equipment tested is a very small transmitter that is packaged 6 different versions. The same transmitter board is used in each configuration. The different packages listed in this report are 1) the Jamb Switch, 2) the 4 inch switch, 3) the 6 inch switch, 4) the Remote 2 switch version 5) Remote 4 switch Version and 6) a Bare Board Transmitter. The only difference between these 6 models are the enclosure packaging and the Remote devices have a daughter board added to include 2 push button switches or 4 push button switches to control output devices. The transmitter pc board is identical on all of the models. The Remote 4 Switch version has two identical transmitters in the same package. Photos of each of these devices are shown below:



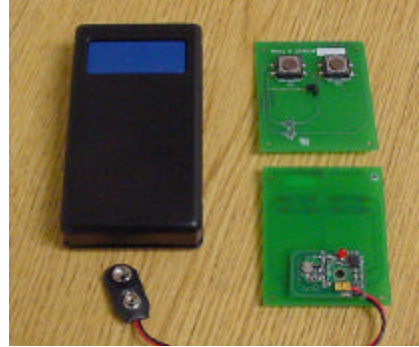
1) Jamb Switch



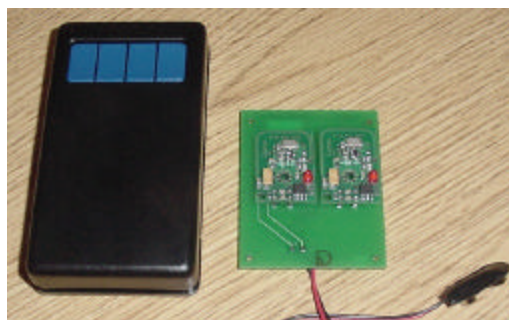
2) 4 inch Switch



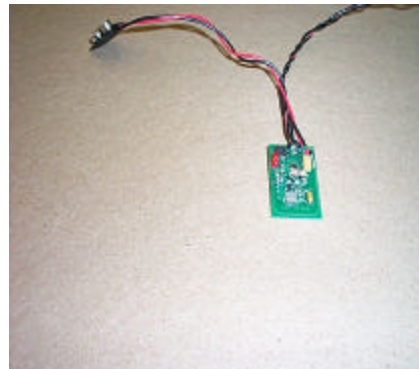
3) 6 inch Switch



4) Remote Two Switch Transmitter



5) Remote 4 Switch Transmitter



6) Bare Transmitter Board

## 2.3 Equipment and Cable Configuration

See photo of the EUT test configuration setup in Attachment A

## 2.4 List of Test Equipment

| <u>Test Equipment</u>      | <u>Model</u>             | <u>S/N</u> | <u>Calibration Due Date</u> |
|----------------------------|--------------------------|------------|-----------------------------|
| Spectrum Analyzer          | Hewlett Packard 8566B    | 2115A00853 | 10/17/04                    |
| Preamp                     | MiniCircuits ZKL-1042j   | DP10150323 | 10/16/04                    |
| Dipole Antenna             | Schwartzbeck UHAP-10dB   | 164        | N/A                         |
| Biconalog Periodic Antenna | Electro Metrics EM-6917B | 106        | 03/18/04                    |
| Ridge Guide Antenna        | EMCO 3115                | 2483       | 03/25/04                    |
| Signal Generator           | Wavetek 2520             | 6271013    | 06/04/04                    |
| Multimeter                 | Fluke 70 III             | 78021032   | N/A                         |
| Temperature Chamber        | Thermotron S-1.2         |            | N/A                         |
| Temperature Probe          | Omega HH23               |            | 09/13/04                    |
| Near Field Probe           | EMCO 7405                |            | N/A                         |
| Spectrum Analyzer          | HP8591E                  |            | 11/13/04                    |

Measurement cable losses, and antenna correction factors are included in the data sheets. The Resolution BW was set at 1 Mhz and the Video BW was set at 1 Hz with a Span of 0 Hz to perform the correct average detected measurements.

## **2.5 Units of Measurement.**

All measurements were taken in dBuV/m with the antenna located at 3 meters distance from the EUT. Frequency measurements are recorded in Mhz

## **2.6 TEST FACILITY**

The open area test site (OATS) and conducted measurement facility used to collect the data was International Certification Services, Inc. at 1100 Falcon Ave. in Glencoe, MN 55336. This site has been certified to be in compliance with the normalized site attenuation section of CISPR 16-1. (See FCC Registration number: 91103 and Industry Canada File number: IC 3701.) International Certification Services, Inc. is also a registered appointed EMC test laboratory for TUV Rheinland Product Safety GmbH, a competent body.

## **2.6 LABORATORY ACCREDITATION**

International Certification Services, Inc. maintains A2LA accreditation to ISO/IEC 17025 for this specific tests listed in A2LA Certificate Number 2055.01 and meets the relevant quality systems requirements of ISO 9001:1994.

## **2.7 Measurement Procedures**

The antenna was placed at a distance of 3 meters from the EUT. The EUT was set on an insulating table in the OATS site and rotated through 360 degrees to determine the worst case EUT orientation. The antenna was then positioned vertical and horizontal to determine which antenna polarity orientation was worst case. Each of the 6 package versions were tested initially to determine which one if any had the largest output signal. All testing was then done on only one model. Then certification data was recorded at all the transmitter frequencies from the fundamental to the 10<sup>th</sup> harmonic at an antenna height variation of from 1-4 meters. A number of iterations were tested to determine what was the best orientation to test and which model to test then all the testing was performed on that model. The different tests performed to determine which unit should be tested for certification and the results of each of those tests are as follows:

| <b>Model</b>              | <b>Test</b>                                                     | <b>Final results</b>                 |
|---------------------------|-----------------------------------------------------------------|--------------------------------------|
| Jamb Switch               | 0, 90, 180, 270 degrees orientation (vertical antenna polarity) | 270 degrees worst case               |
| Jamb Switch               | 0 degrees Vertical and Horizontal antenna polarity              | Vertical antenna polarity worst case |
| Jamb Switch               | 270 degrees Vertical and Horizontal antenna polarity            | Vertical antenna polarity worst case |
| <b>4 inch wall switch</b> | <b>Vertical antenna polarity 270 degrees</b>                    | <b>76.9264 dBuV</b>                  |
| 6 inch wall switch        | Vertical antenna polarity 270 degrees                           | 76.6288 dBuV                         |
| Bare Transmitter board    | Vertical antenna polarity 270 degrees                           | 67.6266 dBuV                         |
| Jamb Switch               | Vertical antenna polarity 270 degrees                           | 71.0248 dBuV                         |

Tests were performed on the Jamb Switch model to determine worst case EUT orientation and antenna polarity. Once this was determined, then all the testing was performed on the worst case model which turned out to be the 4 inch wall switch. The Remote 2 switch version and Remote 4 switch version were not tested because of their very close similarity to the bare board transmitter. The only difference between the two was that a small daughter board was added to the bare transmitter board. This daughter board contained the two or four push button switches to control encoding for external devices.

## 2.8 Reporting Measurement Data

See data sheets and plots in Attachment B.

## 2.9 Radiated Emissions Data

The frequency and amplitude of the tuned frequency of the EUT along with the frequencies and amplitudes of the harmonics up to the 10<sup>th</sup> harmonic are reported in the data sheets in Attachment B. This information is plotted against the limit of section 15.231 of FCC Part 15 subpart C. Both Horizontal and Vertical antenna polarities as well as antenna heights of 1 to 4 meters were observed but all maximum signal strengths occurred in the Vertical antenna polarity and at a 1 meter antenna height.

The Final Level, expressed in dBuV/m, is arrived at by taking the reading from the spectrum analyzer (Level dBuV) and adding the antenna correction factor and cable loss factor (Factor dB) and subtracting the preamp gain. This result then has the FCC limit subtracted from it to provide the margin which gives the tabular data as shown in the data sheets in Attachment B.

Example:

| <u>Frequency</u> | <u>Level</u>  | + | <u>Factor</u> | = | <u>Corr Data</u> | - | <u>FCC Limit</u> | = | <u>Margin</u> |
|------------------|---------------|---|---------------|---|------------------|---|------------------|---|---------------|
| <u>(MHz)</u>     | <u>(dBuV)</u> | + | <u>(dB)</u>   | = | <u>(dBuV/m)</u>  | - | <u>(dBuV/m)</u>  | = | <u>(dB)</u>   |
| 100.0            | 20.6          | + | 11.0          | = | 31.6             | - | 43.5             | = | -11.9         |

## 2.10 Operating Frequency Data for Intentional Radiators

All operating frequencies and harmonic frequencies and ambient temperature at which all data was taken at is recorded in the data sheets in Attachment B.

## 2.11 Occupied Bandwidth Data for Intentional Radiators

The occupied BW data for the EUT is shown in the graphs in Attachment B.

## 2.12 Summary of Results

The EUT passed the requirements of FCC Part 15 Subpart C, Section 15.231 with a minimum passing margin of -3.205 dB (Average Detected signal) at the fundamental frequency of 433.973 Mhz. No modifications were necessary to accomplish this compliance.

## **ATTACHMENT A**

### **RADIATED MEASUREMENT PHOTOS**

#### **TEST SET UP**

**Ultra-Small Transmitter (433.92 Mhz)  
Radiated Emissions  
Test Configuration**



## **ATTACHMENT B**

### **DETAILED DATA SHEETS AND GRAPHS**

Larco Manufacturing Co.  
Model: Ultra Small Transmitter (433.92 Mhz)  
Temperature: 15 Deg C.  
Humidity: 65 % R.H.

Test Technician: Duane R. Bagdons

Center Frequency: 433.92 Mhz

Preliminary testing was done on all models to find out which one if any had the largest radiated signal since all of the 6 models use the same transmitter. Once this was determined, all tests were done on the single unit. Tests were performed with this test configuration and then each frequency was maximized to 0-360 degrees orientation and antenna height of 1-4 meters.

Transmit signal total BW = 380 KHz at 20 dB down from peak carrier amplitude

Certification testing was performed at the OATS site with an antenna distance of 3 meters.

The limit for section 15.231 for frequencies from 260 to 470 Mhz is 3750 to 12,500 uV/m field strength. Using the equation:

**FUNDAMENTAL:**

$41.6667 * (F) - 7083.333$  uV/m

Hence the limit at 433.92 = 10996.68 uV/m

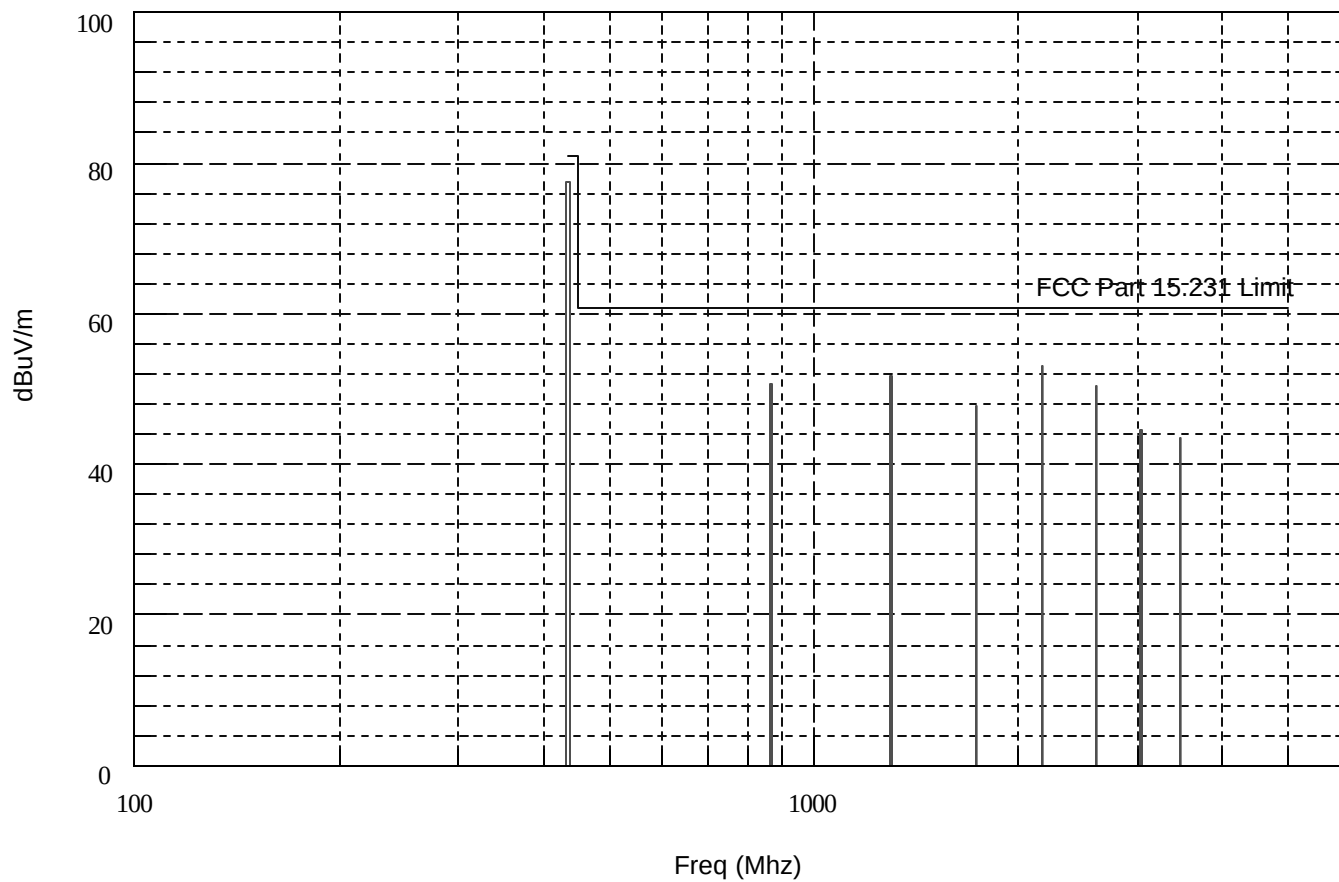
This converts to 80.825 dBuV/m Field strength

**HARMONICS:**

60.825 dBuV/m Field Strength

| Freq (Mhz) | dBuV/m | Corr Data (dBuV/m)<br>Average Detector | FCC 15.231b<br>Limit<br>dBuV/m | Margin (dB) |
|------------|--------|----------------------------------------|--------------------------------|-------------|
| 433.973    | 58     | 77.62                                  | 80.825                         | -3.205      |
| 867.903    | 53.98  | 50.57                                  | 60.825                         | -10.255     |
| 1302       | 49.87  | 51.59                                  | 60.825                         | -9.235      |
| 1736       | 43.45  | 47.84                                  | 60.825                         | -12.985     |
| 2170       | 45.56  | 53.15                                  | 60.825                         | -7.675      |
| 2604       | 41.32  | 50.5                                   | 60.825                         | -10.325     |
| 3038       | 34.36  | 44.44                                  | 60.825                         | -16.385     |
| 3472       | 31.95  | 43.58                                  | 60.825                         | -17.25      |

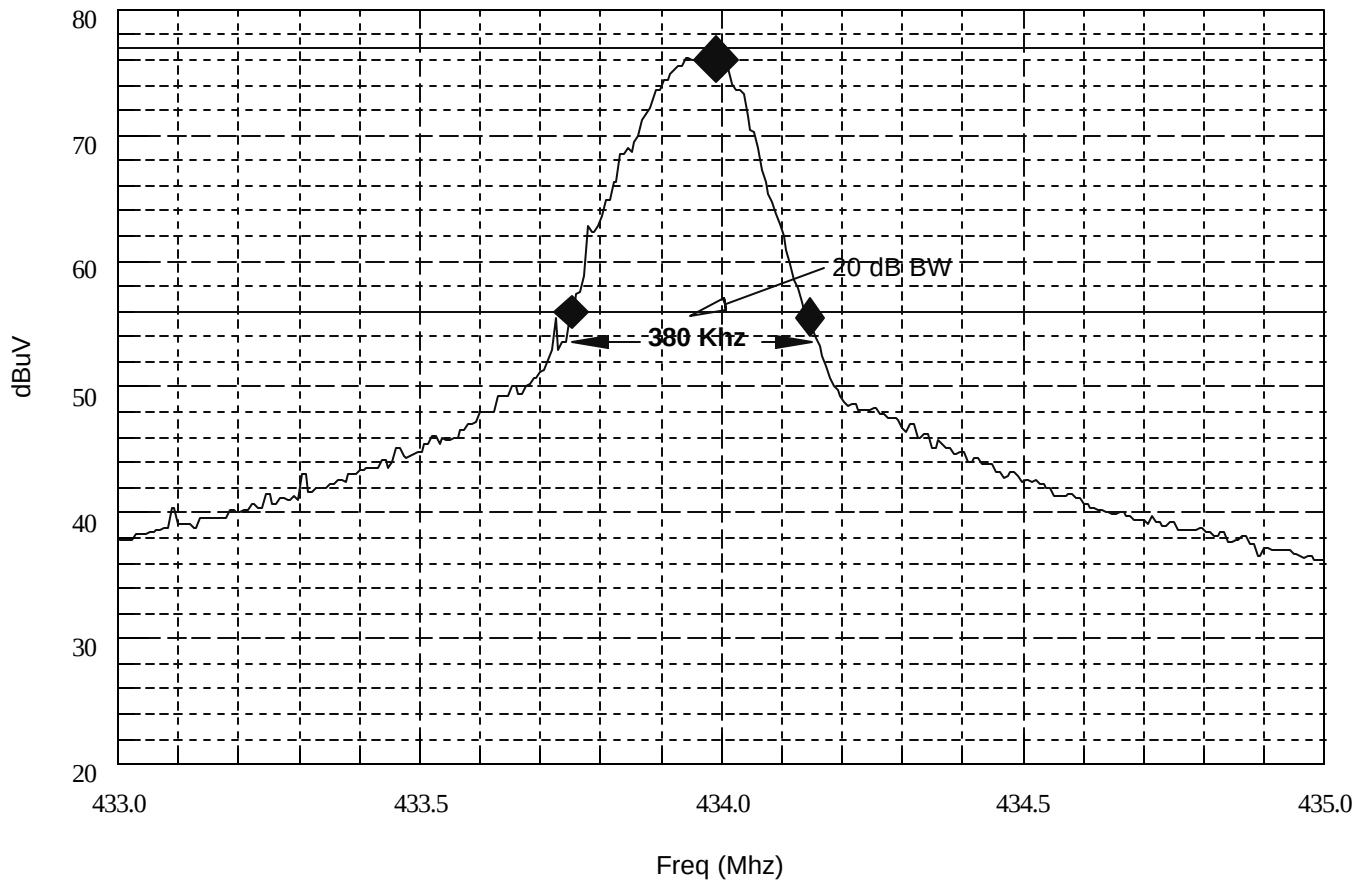
Larco Division of Acrometal  
 Model: Ultra Small Transmitter  
 FCC Part 15.231 Radiated Emissions (Intentional Radiator)  
 Fundamental and Harmonic Frequencies



International Certification Services, Inc.

November 21, 2003

Larco Division of Acrometal  
Ultra Small Transmitter (433.92 Mhz)  
Transmitter Signal Bandwidth (20 dB)



International Certification Services, Inc.

September 9, 2003

## **ATTACHMENT C**

**PRODUCT DATA SHEET OR PRODUCT INFORMATION FORM AS SUPPLIED  
BY THE CUSTOMER**

**COMPANY NAME:** Larco Division of Acrometal

**CUSTOMER REPRESENTATIVE:** International Certification Services, Inc.

**EQUIPMENT DESCRIPTION:** 433.92 Mhz transmitter

**MODEL NUMBER:** Ultra Small Transmitter

**SERIAL NUMBER:** Engineering Unit

**TYPE OF TEST:** \_\_\_\_\_ Development  
\_\_\_\_\_ Initial Design Verification  
\_\_\_\_\_ Design Change (Please describe exact changes below)  
  X   Production Sample (Audit Test)

Changes made: NONE

**OSCILLATOR FREQUENCIES:**

433.92 Mhz

**PRODUCT SHIELDING PROVISION:**

Plastic enclosure and Bare Board

**SOFTWARE AND / OR OPERATING MODES:**

N/A

**I/O CABLES:** NONE