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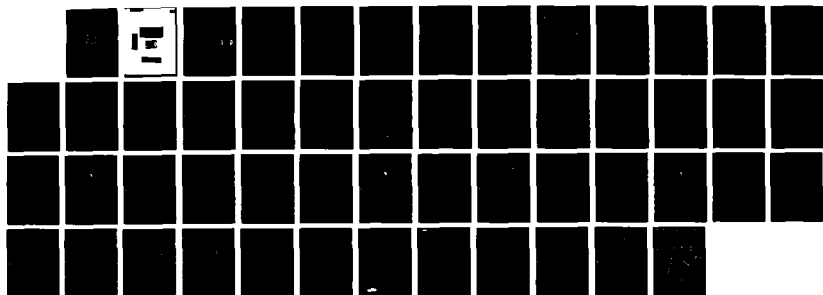
MS-116A HIGH VOLTAGE PROTECTION UNIT(U) MILLER (R A)  
INDUSTRIES INC GRAND HAVEN MI T H SEEKMAN 10 JUL 87  
DAB87-86-C-A010

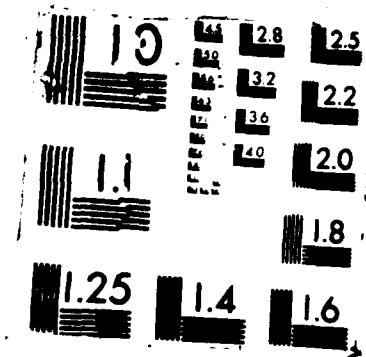
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MS-116A High Voltage Protection Unit  
Final Status Report  
Contract No: DAAD07-88-3-A010  
SIN 0002 Sequence A002  
TAN DI-S-4057

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MS-116A HIGH VOLTAGE PROTECTION UNIT  
FINAL STATUS REPORT

PREPARED BY:  
THOMAS H. SEEKMAN  
R.A. MILLER INDUSTRIES, INC.  
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GRAND HAVEN, MI 49417

JULY 10, 1987

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AUG 05 1987  
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CONTRACT NO: DAAB07-86-C-A010  
CLIN 0002 SEQUENCE A002  
IAW DI-S-4057

PREPARED FOR:  
THE UNITED STATES ARMY  
COMMUNICATIONS ELECTRONICS COMMAND  
FORT MONMOUTH, NJ 07703-5000

CAUTION STATEMENT  
Approved for public release  
Distribution Unlimited

## OVERVIEW

This is the final status report for the development contract DAAB07-86-C-A010. The report is split into two (2) parts, Part 1 is on the development and preliminary testing and Part 2 is on the production and final testing. This was done because, even though both had testing involved, the approach is totally different. The mentality of development and that of production are opposite in every way and each warrants separate reporting. It is intended that each part report everything that was done in a concise but thorough way with conclusions drawn from what has been observed.

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## PART 1: DEVELOPMENT AND PRELIMINARY TESTING

### 1. INTRODUCTION

This status report covers everything that R.A. Miller Industries has accomplished in the area of development and testing of MS-116A High Voltage Protection Unit (HVPU). Included in this report are the status of Mechanical/Electrical Design, Prototype Production, Testing (both Preliminary Design and Finished Prototype), and System Safety Analysis. It is the intention of this reporter to provide a succinct synopsis on each of the afore mentioned scopes. The synopsis will cover all aspects since the commencement of development until the present day.

### 2. OBJECTIVES

#### 2.1 MECHANICAL/ELECTRICAL DESIGN

The Mechanical/Electrical design of the HVPU was conceived after consideration of the operating conditions experienced and the function to be accomplished. Many possible designs were considered, weighing the disadvantages and advantages of each to achieve the optimum result. Preliminary testing played a vital role in the Mechanical/Electrical Design process. The HVPU was developed by close comparative testing with a conventional MS-116A Unit so that the basic characteristics were as similar as possible. The HVPU Mechanical/Electrical Design has been accomplished and a detailed set of drawings to be used for prototype manufacture has been produced.

#### 2.2 TESTING

##### 2.2.1 PRELIMINARY TESTING FOR MECHANICAL/ELECTRICAL DESIGN

Much preliminary testing was required and accomplished in the design phase to achieve the optimum result. In each development test, the prototype HVPU and a conventional MS-116A Unit were subjected to the same conditions and comparisons drawn.

##### 2.2.1.1 FLEXURAL STRENGTH

To compare flexural strength (which is the most important Mechanical design aspect), a fixture which places the Test Specimen parallel to the ground is employed. A dynamometer/force application set-up was used to apply and measure force applied to the tip end (as opposed to the male-threaded end, which is screwed into the fixture) of the Test Specimen at a right angle

to the specimen's axial direction (Perpendicular to the ground). The conventional MS-116A unit was testing first and the force required for failure was noted and used as a target for design. Many plug materials were tested and compared with many fracturing before reaching the design threshold. The chosen plug material, an 80% glass fiber/epoxy resin pultrusion rod exceeded the design threshold before the tube yielded, effectively providing more flexural strength than a conventional MS-116A. See figures 1 and 4 and test reports.

#### 2.2.1.2

##### HIGH VOLTAGE

To check for deleterious effects on the High Voltage Coaxial Capacitor (HVCC) components, the prototypical design was subjected to a 30 KVDC test (which is a greater voltage than the anticipated maximum of 25 KVDC.) The components showed no damage after one (1) minute of continuous application. The test was repeated after subjection to the sag test (2.2.1.3) and there was no difference. See figure 2 and test reports.

#### 2.2.1.3

##### ASSEMBLY DISPLACEMENT (SAG)

The conventional fifteen (15) foot HF Military Whip Antenna (3 MS-116A, 1 MS-117A, and 1 MS-118A Units) was fixtured in a horizontal position and displacement measurements at different places along the assembly's length taken from an assembly using an MS-116A HVPU. The test yielded that the HVPU is more rigid than the standard unit. See figure 3 and test report.

#### 2.2.1.4

##### HVCC CAPACITANCE

The effect of installing a capacitor in the whip had to be determined by analyzing the AN/GRC-106 Radio Set. Since an AN/GRC-106 Radio was not supplied to us, assumptions had to be made. Since the AT-1095A/VRC Modified Upper Whip Section that R.A. Miller is developing has a capacitance value of around 130pf, it was used as a goal. Several lengths and dielectric materials for the capacitor were tried until the target value was achieved.

#### 2.2.1.5

##### BALLISTIC SHOCK

Preliminary testing of the MS-116A HVPU in the whip assembly subjecting it to ballistic shock was deemed necessary before producing the finished prototypes as assurance that the assembly's mechanical integrity was not compromised by the HVPU. An antenna assembly containing an HVPU was subjected to and passed ballistic shock testing.

### 2.2.2

#### PROTOTYPE ENVIRONMENTAL TESTING

Once the one hundred (100) prototype units have been produced they will be divided into five (5) lots of twenty (20) for environmental testing. The environmental tests to be performed are as specified in R.A. Miller Industries' Design Plan which was submitted and accepted in August 1986. A test plan has been written and submitted for acceptance which details the individual test procedures. The division into 5 lots of 20 units was done for time considerations, so not all of the prototypes will be subjected to all the tests.

### 2.3

#### SYSTEM SAFETY ANALYSIS

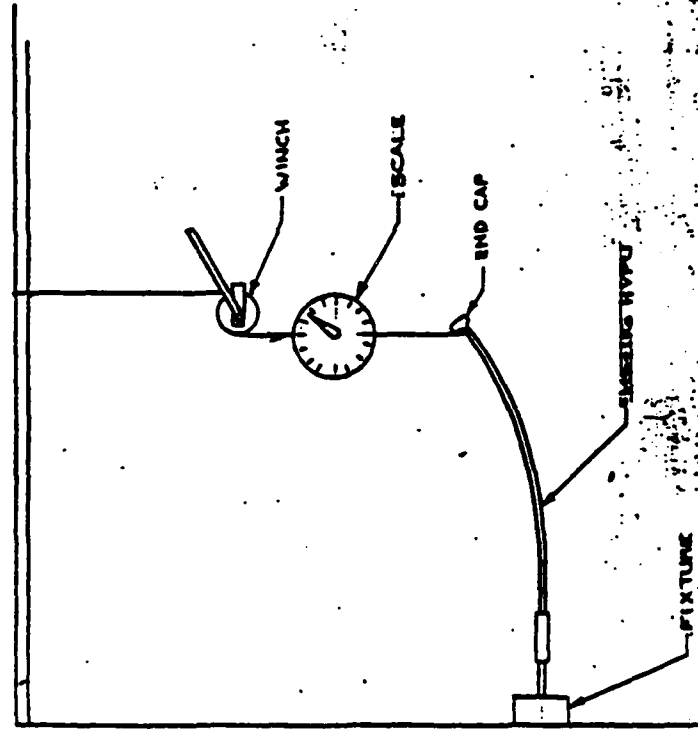
A System Safety Assessment Report was written and submitted in December 1986. It was the report's conclusion that there were no significant factors in the device's design which would have any impact on safety (i.e. no toxic/hazardous materials are used in the HVPU's construction).

### 3.0

#### CONCLUSIONS

It is the conclusion of R.A. Miller Industries that the preliminary design work has been successfully completed. The manufacture of the prototypes will commence immediately with environmental testing to follow upon prototype production completion.

|      |                      |      |       |
|------|----------------------|------|-------|
| SYL. | ADVISORY DESCRIPTION | DATE | APPR. |
|------|----------------------|------|-------|



| ITEM                       | PART NO. | QTY   | DESCRIPTION | MATERIAL          | DATE   |
|----------------------------|----------|-------|-------------|-------------------|--------|
| LIST OF MATERIAL           |          |       |             |                   |        |
| UNLESS OTHERWISE SPECIFIED |          |       |             |                   |        |
| DIMENSIONS ARE IN INCHES   |          |       |             |                   |        |
| TOLERANCES ON DIMENSIONS   |          |       |             |                   |        |
| FRACTIONS DECIMAL ANGLES   |          |       |             |                   |        |
| MATERIAL                   |          |       |             |                   |        |
| FINISH                     |          |       |             |                   |        |
| DRAWN TLK                  |          |       |             |                   |        |
| CHECKED                    |          |       |             |                   |        |
| APPROVED                   |          |       |             |                   |        |
| DATE 12-FEB-67             |          |       |             |                   |        |
| SCALE NONE                 |          |       |             |                   |        |
| R. A. WALLER INC. INC.     |          |       |             |                   |        |
| GRAND HAVEN, MICH.         |          |       |             |                   |        |
| USED ON                    |          |       |             |                   |        |
| ANTENNA                    |          |       |             |                   |        |
| REC'D                      | SUB-ASST | REC'D |             |                   |        |
|                            |          |       |             | FLEXURAL STRENGTH |        |
|                            |          |       |             | TEST SET-UP       |        |
|                            |          |       |             |                   | SH. OF |

Figure 1

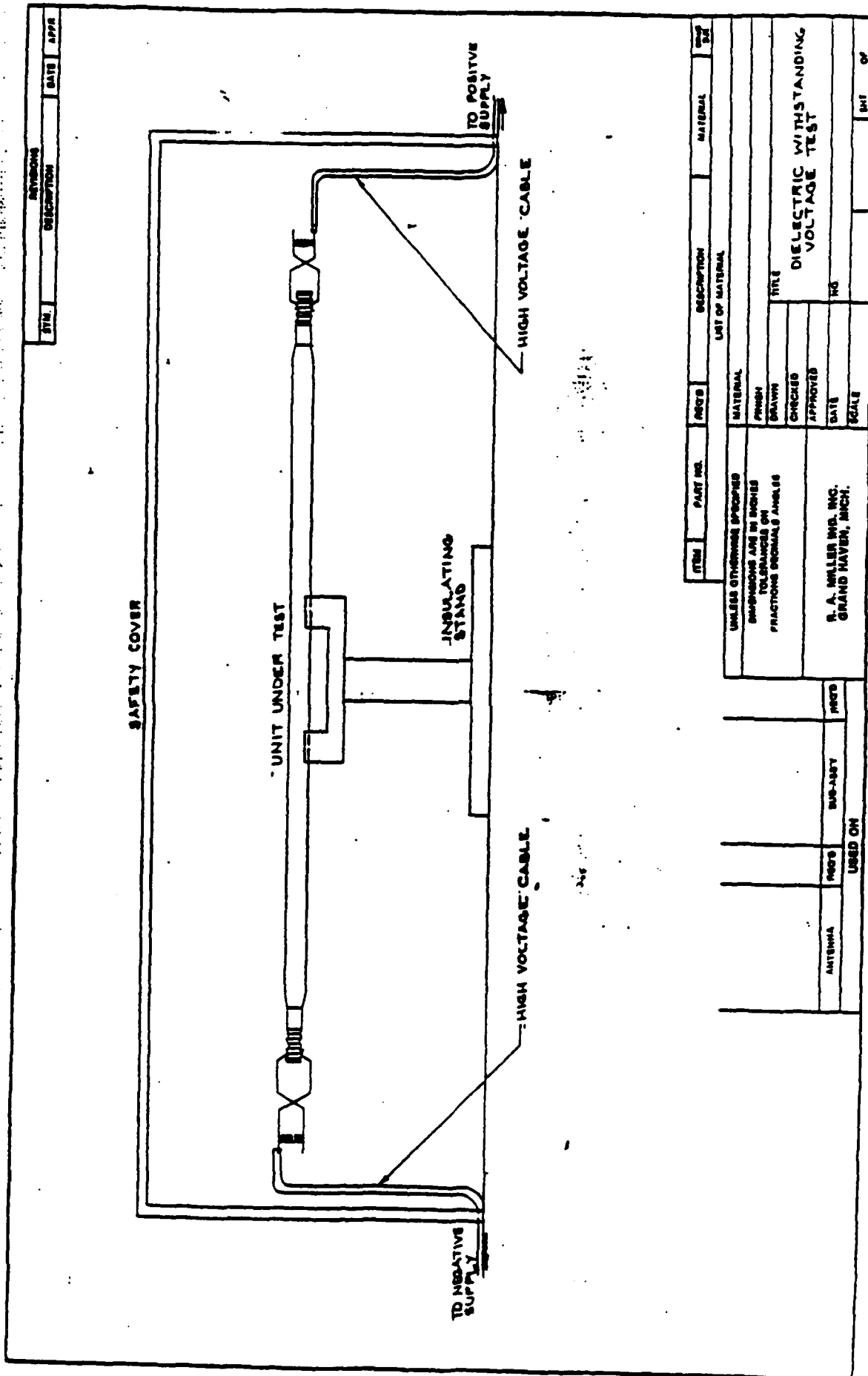
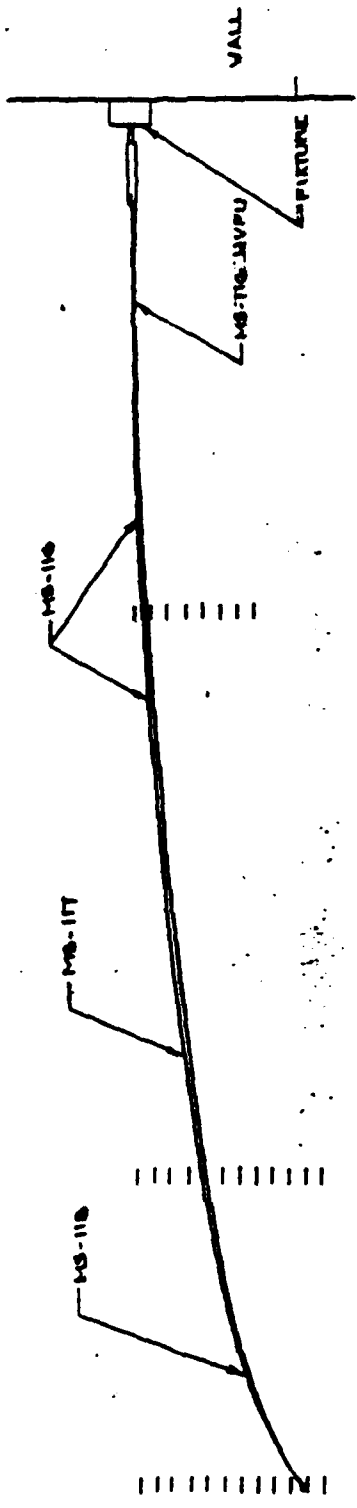


Figure 2

REVISED DESCRIPTION DATE APPR

NOTE: HASH MARKS USED TO MEASURE DISPLACEMENT (SAG).



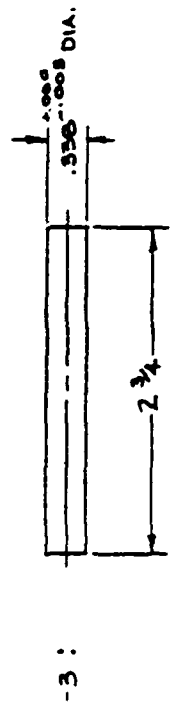
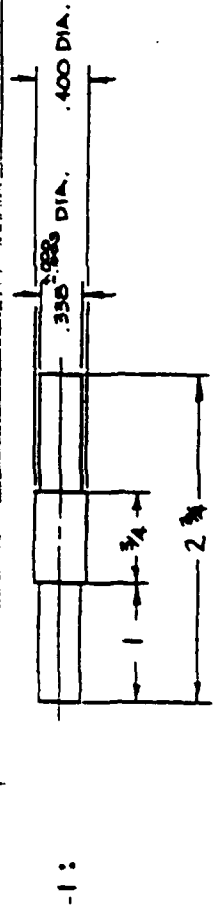
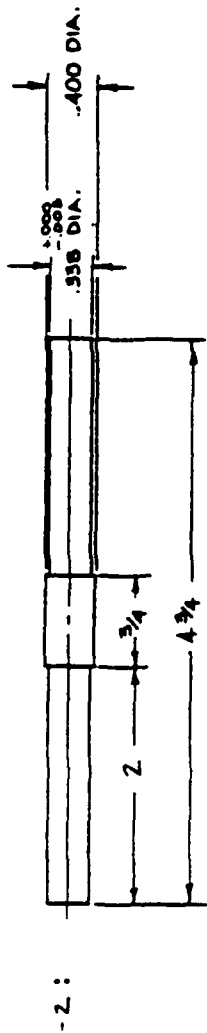
| ITEM                       | PART NO. | REQS | DESCRIPTION | MATERIAL | DATE | BY |
|----------------------------|----------|------|-------------|----------|------|----|
| LIST OF MATERIAL           |          |      |             |          |      |    |
| MATERIAL                   |          |      |             |          |      |    |
| UNLESS OTHERWISE SPECIFIED |          |      |             |          |      |    |
| DIMENSIONS ARE IN INCHES   |          |      |             |          |      |    |
| TOLERANCES ON              |          |      |             |          |      |    |
| FRACTIONS DECIMALS ANGLES  |          |      |             |          |      |    |
| DRAWN TLM                  |          |      |             |          |      |    |
| CHECKED                    |          |      |             |          |      |    |
| APPROVED                   |          |      |             |          |      |    |
| DATE 13-FEB-61             |          |      |             |          |      |    |
| SCALE NONE                 |          |      |             |          |      |    |
| TITLE                      |          |      |             |          |      |    |
| ASSEMBLY DISPLACEMENT      |          |      |             |          |      |    |
| (SAG) TEST SET UP          |          |      |             |          |      |    |
| S. A. MILLER INC. INC.     |          |      |             |          |      |    |
| GRAND HAVEN, MICH.         |          |      |             |          |      |    |

| ANTENNA | REQS | SUB-ASST | REQS |
|---------|------|----------|------|
|         |      |          |      |
| USED ON |      |          |      |

Figure 3

|          |             |      |       |
|----------|-------------|------|-------|
| REV. NO. | DESCRIPTION | DATE | APPR. |
|----------|-------------|------|-------|

MAT'L: -1: 70% GLASS-  
30% POLYESTER RESIN.  
-2: 80% GLASS-  
20% EPOXY RESIN PULTRUSION.



| ITEM             | PART NO. | REQ'D             | DESCRIPTION | MATERIAL | QTY | UNIT |
|------------------|----------|-------------------|-------------|----------|-----|------|
| LIST OF MATERIAL |          |                   |             |          |     |      |
| MATERIAL         |          | SEE NOTE          |             |          |     |      |
| FINISH           |          | N/A               |             |          |     |      |
| DRAWN            |          | TLK               |             |          |     |      |
| CHECKED          |          | THS.              |             |          |     |      |
| APPROVED         |          |                   |             |          |     |      |
| DATE             |          | 6-MAR-67          |             |          |     |      |
| SCALE            |          | FULL              |             |          |     |      |
| MO               |          | RAM 116-2-1, L. 3 |             |          |     |      |
| TITLE            |          | PLUG DESIGNS      |             |          |     |      |

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ON  
FRACTIONS NORMAL ANGLES  
1/64 ±.005

R. A. MILLER IND. INC.  
GRAND HAVEN, MICH.

| ANTENNA | REQ'D | SUB-ASBY | REQ'D |
|---------|-------|----------|-------|
|         |       |          |       |

USED ON

Figure 4  
8

MS-116A HVPU Flexural

Test Report

Contract: DAAB07-86-C-A010

Test Date: 25-JULY-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 966 lb.

Remarks: Failure in the standard unit was determined when tube  
buckling occurred. The HVPU also failed when tube buckled and there  
was no visible damage in the plug area. The plug area was covered  
with a fiberglass cloth wrap which adds to the profile of the unit.  
The plug material used was a 70% glass, 30% polyester resin which is  
also used for AT-1095 whip cores. A test will be performed on a test  
item without the fiberglass cloth wrap to determine if it is required.

Test Witnessed By:

Thomas H. Seekman

THOMAS SEEKMAN-MECH. ENG. 25-JUL-86

Ben Fanning

ELECT. ENG.

25 JUL 86

MS-116A HVPU Flexural

Test Report

Contract: DAAB07-86-C-A010

Test Date: 29-JULY-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 704 lb.

Remarks: The test item failed at a much lower force value than in  
the first test. Failure occurred with a brittle fracture of the  
core material. The fiberglass cloth wrap is necessary for flexural  
strength. Another test item will be manufactured and tested to  
verify that the design is satisfactory.

Test Witnessed By:

Thomas H. Seekman THOMAS SEEKMAN-MECH. ENG. 29-JUL-86

Bill Emery ELECT ENG 29 JUL 86

MS-116A HVPU Flexural

Test Report

Contract: DAAB07-86-C-A010

Test Date: 14-OCTOBER-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 860 lb.

Remarks: The HVPU failed via brittle fracture of the plug material  
and the fiberglass cloth wrap. This failure was totally unanticipated  
because of the initial test's success. Manufacturing techniques will  
be scrutinized as the probable cause of the premature failure.  
Alternate plug materials and shapes will be researched also.

Test Witnessed By:

Thomas H. Seekman

THOMAS SEEKMAN-MECH. ENG. 14-OCT-86

Ben Pomeroy

ELECT ENG

14 OCT 86

MS-116A HVPU Flexural

Test Report

Contract: DAAB07-86-C-A010

Test Date: 21-NOVEMBER-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 752 lb.

Remarks: The plug's overall length was increased by two (2) inches  
for added adhesion but brittle fracture occurred. The added moment  
arms caused by the increased length caused the fracture. The plug  
material seems to be weaker when the step is machined in it also.  
A solid plug design will be implement and a stronger material will  
be researched and procured.

Test Witnessed By:

Thomas H. Seekman

THOMAS SEEKMAN-MECH. ENG. 21-NOV-86

Ben Pinnings

ELECT ENG

21 NOV 86

MS-116A HVPU Flexural

Test Report

Contract: DAAB07-86-C-A010

Test Date: 6-FEBRUARY-1987

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 1024 lb.

Remarks: A solid plug of 80% glass, 20% epoxy resin was used.

The diameter of the plug was .025" undersize and didn't have the  
fiberglass cloth wrap. Failure occurred via tube buckling. It was  
determined that the 80% glass, 20% epoxy resin material is the best  
material available. The unprotected material showed only a small  
amount of crazing and provided more flexural strength than the solid  
steel tube. The proper diameter and an overwrap will be used.

Test Witnessed By:

Thomas H. Seekman THOMAS SEEKMAN - MECH. ENG. 6-FEB-87

R. J. Summers ELECT ENG (6 FEB 87)

MS-116A HVPU  
High Voltage Test Report

Contract: DAAB07-86-C-A010

Test Date: 26-June-1986

Test Voltage (KV)

Current Leakage (uA)

25  
30

1  
1.5

Remarks: The test item was tested at 25KV and 30KV (5KV more than  
required for added assurance) and showed no detrimental effects with the  
current leakage values recorded. There is no evidence of arcing, neither  
auditory or visual and no burn marks were found on the item.

Test Witnessed By:

Ben Emmerson

ELECT ENG

26 JUN 86

MS-116A HVPU  
High Voltage Test Report

Contract: DAAB07-86-C-A010

Test Date: 5-March-1987

Test Voltage (KV)

Current Leakage (mA)

25  
30

1  
1.5

Remarks: The test item was high voltage tested after being subjected to  
to the assembly displacement (SAG) test to check if the stresses encountered  
induced any detrimental effects to the capacitive capability of the HVPU.  
It was found that there was negligible effect in the measurements.

Test Witnessed By:

*Thomas H. Seekman*

THOMAS SEEKMAN-MECH. ENG. 5-MAR-87

*Paul Miller*

Paul Miller - Engineering Manager 5-MAR-87

Antenna MS-116A Assembly  
Displacement (SAG) Test

Contract: DAAB07-86-C-A010

Test Dates: 3-March-1987 to 5-March-1987

Standard Unit

|       | <u>Time</u> | <u>Wall Mount</u> | <u>1st Joint</u> | <u>2nd Joint</u> | <u>3rd Joint</u> | <u>4th Joint</u> | <u>Tip</u> |
|-------|-------------|-------------------|------------------|------------------|------------------|------------------|------------|
| 3-MAR | 8:00 AM     | 107               | 103½             | 95               | 84               | 72               | 60         |
|       | 9:00 AM     | 107               | 103½             | 94 3/4           | 83 3/4           | 72               | 59 3/4     |
|       | 10:00 AM    | 107               | 103½             | 94 3/4           | 83 3/4           | 72               | 59 3/4     |
|       | 11:00 AM    | 107               | 103½             | 94 3/4           | 83 3/4           | 72               | 59 3/4     |
|       | 1:00 PM     | 107               | 103½             | 94 3/4           | 83 3/4           | 72               | 59 1/2     |
|       | 3:00 PM     | 107               | 103½             | 94 3/4           | 83 3/4           | 72               | 59 1/2     |
|       | 8:00 AM     | 107               | 103½             | 94 3/4           | 83 3/4           | 72               | 59 1/2     |

HVPU Unit

|       | <u>Time</u> | <u>Wall Mount</u> | <u>1st Joint</u> | <u>2nd Joint</u> | <u>3rd Joint</u> | <u>4th Joint</u> | <u>Tip</u> |
|-------|-------------|-------------------|------------------|------------------|------------------|------------------|------------|
| 4-MAR | 8:00 AM     | 107               | 103½             | 95 3/8           | 84 3/4           | 74               | 62 3/8     |
|       | 9:00 AM     | 107               | 103½             | 95 1/4           | 84 3/4           | 73 1/2           | 62         |
|       | 10:00 AM    | 107               | 103½             | 95 1/4           | 84 3/4           | 73 3/8           | 61 3/4     |
|       | 11:00 AM    | 107               | 103½             | 95               | 84 3/8           | 73 1/4           | 61 5/8     |
|       | 1:00 PM     | 107               | 103½             | 95               | 84 1/4           | 73 1/8           | 61 3/8     |
|       | 3:00 PM     | 107               | 103½             | 95               | 84 1/4           | 73 1/8           | 61 3/8     |
| 5-MAR | 8:00 AM     | 107               | 103 3/8          | 94 7/8           | 84 1/8           | 72 7/8           | 61 1/8     |

\*All measurements in inches from floor

Test Witnessed By:

Paul Miller 3/5/87  
Paul Miller Engineering Manager

Thomas H. Seekman 5-MARCH-1987  
Tom Seekman Mechanical Engineer

Jim Clark 3/5/87  
Jim Clark Test Engineer

Mary Ramirez, QAR 05 March 1987  
Mary Ramirez QAR

## PART 2: PRODUCTION AND TESTING

### 1 INTRODUCTION

This status report covers the aspects of R.A. Miller Industries' production and subsequent production testing of the MS-116A High Voltage Protection Unit (HVPU). Included in this report are the status of Prototype Production and Testing, Final Test Report Excerpts, and the final conclusions of the design team. It is intended that this report provide a succinct synopsis of all aspects since the commencement of production until its completion.

### 2 OBJECTIVES

#### 2.1 PRODUCTION OF HVPU

Upon completion of the design/development phase, the one hundred (100) prototype unit production phase commenced. In the production phase, manufacturing techniques had to be developed for use on the HVPU's. While these techniques produced very satisfactory results, they are by no means 100% perfect nor would they be expected to be. Fine-tuning of these techniques would be expected on any future production. These fine-tunements would not adversely affect the performance of the HVPU since the basics of techniques will remain unchanged.

#### 2.2 TESTING

Upon completion of the production of the HVPU's, the First Article Product Assurance Testing commenced as was set forth in our Test Plan (submitted 26-February-1987) with five (5) lots of twenty (20) antennae. The HVPU's were subjected to the following sequence of tests: Capacitance, Visual/Mechanical, High Voltage Stress, Voltage Standing Wave Ratio, High temperature, Low Temperature, Ballistic Shock, Humidity, Vibration, and Impedance (order of tests). The HVPU's passed all the tests without any failures (See Figure 1-Final Test Report Excerpts).

A special testing note: This is to explain the rather large discrepancy between the leakage current values measured in the development preliminary testing and the ones measured during prototype production testing (1mA vs. 4mA). During the development testing the HVPU was fixtured differently than during the production testing and it was discovered that positioning in the fixture affected the leakage current because the fixture had leakage through it also. Another reason for the

discrepancy is the fact that during development testing the humidity level was much lower than it was during the production testing. High humidity causes more leakage to occur. The values recorded for production testing were the worst values obtainable. The HVPU's were moved in the fixture until the worst value (highest value for leakage current) was found.

3.0

#### CONCLUSIONS

It is the conclusion of R.A. Miller Industries that the production prototypes will offer the desired high voltage protection without compromising the mechanical integrity of the whip. It has been shown that the flexural properties have been actually improved with the inclusion of the capacitance unit. The flexural strength of the HVPU was increased over that of the standard MS-116 and the assembly is more rigid because of the HVPU's presence. This will enhance the stability of the assembly by eliminating harmonic frequencies when it is vibrated during operation.

FIGURE 1

1.0 INTRODUCTION

A high voltage coaxial capacitor is fitted within the MS-116 lowest section. The purpose of the coaxial capacitor is to protect military vehicle personnel from high voltage shock if the vehicle's whip antenna contacts an overhead powerline (typically 15-20 KVRMS).

After final design of the MS-116 HVPU is complete, one hundred units shall be built. They will be spilt into five lots of 20 so that different tests may be ongoing at the same time to speed testing. The units will be stepped through the following tests according to 2.0 Test Requirements.

1.1 MANUFACTURER

R.A. Miller Industries, Inc.  
P.O. Box 858  
14500 168th Avenue  
Grand Haven, MI 49417

1.2 DRAWING SPECIFICATION OF EXHIBIT

The 100 116 HVPU's will be IAW CENCOMS technical requirements COM-TR-033-01, dated 15 APR 85.

1.3 QUANTITY OF ITEMS TO BE TESTED

(100) One Hundred

1.4 SECURITY OF ITEMS TO BE TESTED

Unclassified

1.5 DATE BY WHICH TESTS ARE TO BE COMPLETED

May 30, 1987

1.6 DISPOSITION OF SPECIMENS

To be shipped to:

Consolidated Property Office  
Building 117  
Fort Monmouth, NJ 07703

Mark for:

AMSEL-RD-COM-TR-I  
Building 39, Evans Area  
Contract DAA807-86-C-A010

## 2.0 Test Requirements

| Test                  | SEC. | MS-116 HVPU S/N / Order of Tests |       |       |       |        |   |    |     |   |   | **** |       |
|-----------------------|------|----------------------------------|-------|-------|-------|--------|---|----|-----|---|---|------|-------|
|                       |      | 1-20                             | 21-40 | 41-60 | 61-80 | 81-100 | * | ** | *** |   |   |      |       |
| Capacitance           | 6-1  | 1                                | 1     | 1     | 1     | 1      | X |    |     |   |   |      | 1/2   |
| Visual Mechanical     | 6-2  | 2                                | 2     | 2     | 2     | 2      |   |    |     |   |   |      | 1/2   |
| High Voltage Stress   | 6-3  | 3                                | 3     | 3     | 3     | 3      |   |    |     |   |   | X    | 1/2   |
| VSWR                  | 6-4  | 4                                | 4     | 4     | 4     | 4      |   |    |     |   | X |      | 1/2   |
| High Temperature      | 6-5  |                                  | 5     |       | 5     |        |   |    |     |   |   |      | 1 1/2 |
| Low Temperature       | 6-6  | 5                                |       |       |       |        |   |    |     |   |   |      | 1 1/2 |
| Ballistic Shock       | 6-7  |                                  |       |       |       |        |   |    |     | 5 | X |      | 7     |
| Humidity <sup>1</sup> | 6-8  |                                  | 6     |       |       |        |   |    |     |   |   |      | 14    |
| Vibration             | 6-9  |                                  |       |       |       | 6      |   |    |     |   | X |      | 3     |
| Impedance             | 6-10 | 6                                |       |       |       | 6      |   |    |     |   | X |      | 2     |

NOTE: 1. \* = Test before unit complete

2. \*\* = Uses complete 15 foot whip assembly

3. \*\*\* = This test repeated as post testing

4. \*\*\*\* = Test duration per lot (20 unit) in days (not including post testing)

3.0 STANDARD TEST CONDITIONS

Unless otherwise specified, the following standard test conditions shall prevail during testing:

| <u>CONDITION</u> | <u>VALUE/TOLERANCE</u> |
|------------------|------------------------|
| Temperature      | Prevailing ambient     |
| Altitude         | Ground level           |

4.0 LIST OF TEST EQUIPMENT

| <u>EQUIPMENT NAME</u>                                  | <u>REF</u> |
|--|------------|
| Capacitance Meter<br>Sencore LC53                      | 6.2        |
| Model 05460A D.C.<br>Hypot - Assoc.<br>Research Inc.   | 6.3        |
| Wiltron Model 640<br>Network Analyzer                  | 6.4        |
| Hewlit Packard Model<br>4191A RF Impedance<br>Analyzer | 6.10       |

Equivalent equipments may be substituted.

5.0 LIST OF ABBREVIATIONS

1. HVPU - High Voltage Protection Unit
2. S/N - Serial Number
3. pF - Pico Farads
4. mA - Micro amperes
5. R.F. - Radio Frequency
6. Cu - Copper
7. R. Loss - Return Loss
8. VSWR - Voltage Standing Wave Ratio
9. F - Farenheit
10. C - Centigrade
11. Fig. - Figure
12. +ve - Positive
13. MHz - MegaHertz
14. Sec. - Section
15. Q.C. - Quality Control
16. Rep. - Representative
17. Gov't - Government

c. CAPACITANCE TEST DATA SHEET

MS-116 HVPU

DATE: 6-4-87 TESTED BY: Jim Clark  
 S/N: A WITNESS: Anthony Sharriff N/A  
 QC REP RAM 2 GOV'T REP

| S/N | CAPACITANCE<br>in pF | S/N | CAPACITANCE<br>in pF |
|-----|----------------------|-----|----------------------|
| 1   | 138                  | 11  | 140                  |
| 2   | 142                  | 12  | 142                  |
| 3   | 139                  | 13  | 142                  |
| 4   | 141                  | 14  | 142                  |
| 5   | 140                  | 15  | 143                  |
| 6   | 142                  | 16  | 140                  |
| 7   | 141                  | 17  | 140                  |
| 8   | 139                  | 18  | 141                  |
| 9   | 142                  | 19  | 143                  |
| 10  | 142                  | 20  | 143                  |

VISUAL AND MECHANICAL TEST DATA SHEET

MS-116 HVPU

DATE: 6-12-87      INSPECTED BY: Amy Hudd  
 S/N: A      WITNESS BY: Amy Hudd      Amy Hudd      N/A  
 QC REP      GOV'T REP

**RAM 4**

| <u>CHARACTERISTIC</u> | <u>ACTUAL MEASUREMENT RESULTS</u> | <u>PASS (X)</u> | <u>FAIL (X)</u> |
|-----------------------|-----------------------------------|-----------------|-----------------|
| Overall Length        | 39 1/2 ± 1/4                      | X               |                 |
| Upper Threads         |                                   | X               |                 |
| * Upper Diameter      |                                   |                 |                 |
| Upper Taper           |                                   | X               |                 |
| * Lower Threads       |                                   |                 |                 |
| * Lower Taper         |                                   |                 |                 |
| Surface Finish        |                                   | X               |                 |
| Cleanliness           |                                   | X               |                 |
| Workmanship           |                                   | X               |                 |

Comments: \*Verified though Interchabilty  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

OVERALL LENGTH

MS-116 HVPU

DATE: 6-12-87

INSPECTED BY: Amy Hudd

WITNESS BY: Amy Hudd

Q.C. REP GOV'T RE

RAM 4

REQUIREMENT:  $39 \frac{1}{2} \pm \frac{1}{4}$

| <u>S/N</u> | <u>ACTUAL</u>   | <u>PASS</u> | <u>FAIL</u>  |
|------------|-----------------|-------------|--------------|
| <u>1</u>   | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>2</u>   | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>3</u>   | <u>39 17/32</u> | <u>-X</u>   | <u>_____</u> |
| <u>4</u>   | <u>39 9/16</u>  | <u>X</u>    | <u>_____</u> |
| <u>5</u>   | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>6</u>   | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>7</u>   | <u>39 1/2</u>   | <u>X</u>    | <u>_____</u> |
| <u>8</u>   | <u>39 9/16</u>  | <u>X</u>    | <u>_____</u> |
| <u>9</u>   | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>10</u>  | <u>39 9/16</u>  | <u>X</u>    | <u>_____</u> |
| <u>11</u>  | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>12</u>  | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>13</u>  | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>14</u>  | <u>39 9/16</u>  | <u>X</u>    | <u>_____</u> |
| <u>15</u>  | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>16</u>  | <u>39 19/32</u> | <u>X</u>    | <u>_____</u> |
| <u>17</u>  | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>18</u>  | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |
| <u>19</u>  | <u>39 9/16</u>  | <u>X</u>    | <u>_____</u> |
| <u>20</u>  | <u>39 17/32</u> | <u>X</u>    | <u>_____</u> |

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-12-87

TESTED

*Jim Clark*  
Jim Clark

S/N: B

WITNESS

Connie Lyles

N/A

QC REP *Connie Lyles*

GOV'T REP

ANTENNA  
S/N

WITHSTOOD DIELECTRIC BREAKDOWN  
YES NO

| ANTENNA S/N | WITHSTOOD DIELECTRIC BREAKDOWN | YES | NO            |
|-------------|--------------------------------|-----|---------------|
| <u>21</u>   | <u>3.2 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>22</u>   | <u>3.9 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>23</u>   | <u>4.0 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>24</u>   | <u>3.7 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>25</u>   | <u>3.5 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>26</u>   | <u>4.1 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>27</u>   | <u>3.7 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>28</u>   | <u>3.8 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>29</u>   | <u>3.7 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>30</u>   | <u>3.4 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>31</u>   | <u>2.9 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>32</u>   | <u>3.0 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>33</u>   | <u>4.0 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>34</u>   | <u>3.0 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>35</u>   | <u>3.6 <math>\mu</math>A</u>   |     | <u>      </u> |
| <u>36</u>   | <u>2.5 <math>\mu</math>A</u>   |     | <u>      </u> |

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-12-87 TESTED Jim Clark  
S/N: B WITNESS: Connie Lyles QC REP Connie Lyles N/A GOV'T REP

| ANTENNA<br>S/N | WITHSTOOD DIELECTRIC BREAKDOWN |             |
|----------------|--------------------------------|-------------|
|                | YES                            | NO          |
| <u>37</u>      | <u>3.7 <math>\mu</math>A</u>   | <u>    </u> |
| <u>38</u>      | <u>3.8 <math>\mu</math>A</u>   | <u>    </u> |
| <u>39</u>      | <u>2.8 <math>\mu</math>A</u>   | <u>    </u> |
| <u>40</u>      | <u>2.6 <math>\mu</math>A</u>   | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |
| <u>    </u>    | <u>    </u>                    | <u>    </u> |

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip *Sandy D'Oyly*

DATE: 6-12-87

TESTED BY

Sandy D'Oyly

Lot B

WITNESS

*Connie Lyles*  
Connie Lyles

N/A

QC REP

GOV'T REP

| S/N             | Frequency of resonance in MHz | R Loss | VSWR |
|-----------------|-------------------------------|--------|------|
| 21              | 19.5                          | 26     | 1.11 |
| 22              | 19.6                          | 26     | 1.11 |
| 23              | 19.6                          | 24     | 1.13 |
| 24              | 19.6                          | 25     | 1.12 |
| 25              | 19.6                          | 23     | 1.15 |
| 26              | 19.7                          | 25     | 1.12 |
| 27              | 19.5                          | 27     | 1.09 |
| 28              | 19.6                          | 28     | 1.08 |
| 29              | 19.5                          | 27     | 1.09 |
| 30              | 19.5                          | 28     | 1.08 |
| 31              | 19.5                          | 28     | 1.08 |
| 32              | 19.6                          | 26     | 1.11 |
| 33              | 19.4                          | 27     | 1.09 |
| 34              | 19.4                          | 28     | 1.08 |
| 35              | 19.6                          | 27     | 1.09 |
| 36              | 19.6                          | 26     | 1.11 |
| 37              | 19.5                          | 27     | 1.09 |
| 38              | 19.5                          | 27     | 1.09 |
| 39              | 19.4                          | 28     | 1.08 |
| 40              | 19.5                          | 28     | 1.08 |
| Standard MS 116 | 17.2                          | 22     | 1.17 |



POST HIGH TEMP  
PRE HUMIDITY

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip *Jim Clark*

DATE: 6-17-87

TESTED BY *Jim Clark*

Lot B

WITNESS Connie Lyles

N/A

QC REP

*Connie Lyles*

GOV'T REP

| S/N             | Frequency of resonance in MHz | R Loss | VSWR |
|-----------------|-------------------------------|--------|------|
| 21              | 19.3                          | 30     | 1.06 |
| 22              | 19.5                          | 27     | 1.09 |
| 23              | 19.5                          | 30     | 1.06 |
| 24              | 19.5                          | 32     | 1.04 |
| 25              | 19.5                          | 30     | 1.06 |
| 26              | 19.5                          | 29     | 1.07 |
| 27              | 19.5                          | 30     | 1.06 |
| 28              | 19.3                          | 33     | 1.04 |
| 29              | 19.5                          | 30     | 1.06 |
| 30              | 19.5                          | 28     | 1.08 |
| 31              | 19.3                          | 28     | 1.08 |
| 32              | 19.5                          | 28     | 1.08 |
| 33              | 19.5                          | 30     | 1.06 |
| 34              | 19.3                          | 30     | 1.06 |
| 35              | 19.5                          | 32     | 1.04 |
| 36              | 19.5                          | 30     | 1.06 |
| 37              | 19.4                          | 30     | 1.06 |
| 38              | 19.4                          | 30     | 1.06 |
| 39              | 19.3                          | 31     | 1.05 |
| 40              | 19.3                          | 32     | 1.04 |
| Standard MS 116 | 17.2                          | 22     | 1.17 |

POST HIGH TEMP  
PRE HUMIDITY  
HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-17-87

TESTED *Jim Clark*  
*Jim Clark*

S/N: B

WITNESS: *Connie Lyles* N/A

QC REP *Connie Lyles* GOV'T REP

| ANTENNA<br>S/N | WITHSTOOD DIELECTRIC BREAKDOWN |       |
|----------------|--------------------------------|-------|
|                | YES                            | NO    |
| <u>21</u>      | <u>3.1kV</u> A                 | _____ |
| <u>22</u>      | <u>4.0kV</u> A                 | _____ |
| <u>23</u>      | <u>3.9kV</u> A                 | _____ |
| <u>24</u>      | <u>3.6kV</u> A                 | _____ |
| <u>25</u>      | <u>3.7kV</u> A                 | _____ |
| <u>26</u>      | <u>4.2kV</u> A                 | _____ |
| <u>27</u>      | <u>3.5kV</u> A                 | _____ |
| <u>28</u>      | <u>4.2kV</u> A                 | _____ |
| <u>29</u>      | <u>3.9kV</u> A                 | _____ |
| <u>30</u>      | <u>3.3kV</u> A                 | _____ |
| <u>31</u>      | <u>3.3kV</u> A                 | _____ |
| <u>32</u>      | <u>2.9kV</u> A                 | _____ |
| <u>33</u>      | <u>4.3kV</u> A                 | _____ |
| <u>34</u>      | <u>3.2kV</u> A                 | _____ |
| <u>35</u>      | <u>3.6kV</u> A                 | _____ |
| <u>36</u>      | <u>2.7kV</u> A                 | _____ |

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



IMPEDANCE TEST DATA SHEET

MS-116 EWPV Incorporated in the 15 foot whip assembly

DATE: 6-23-87 TESTED BY: Jim Clark

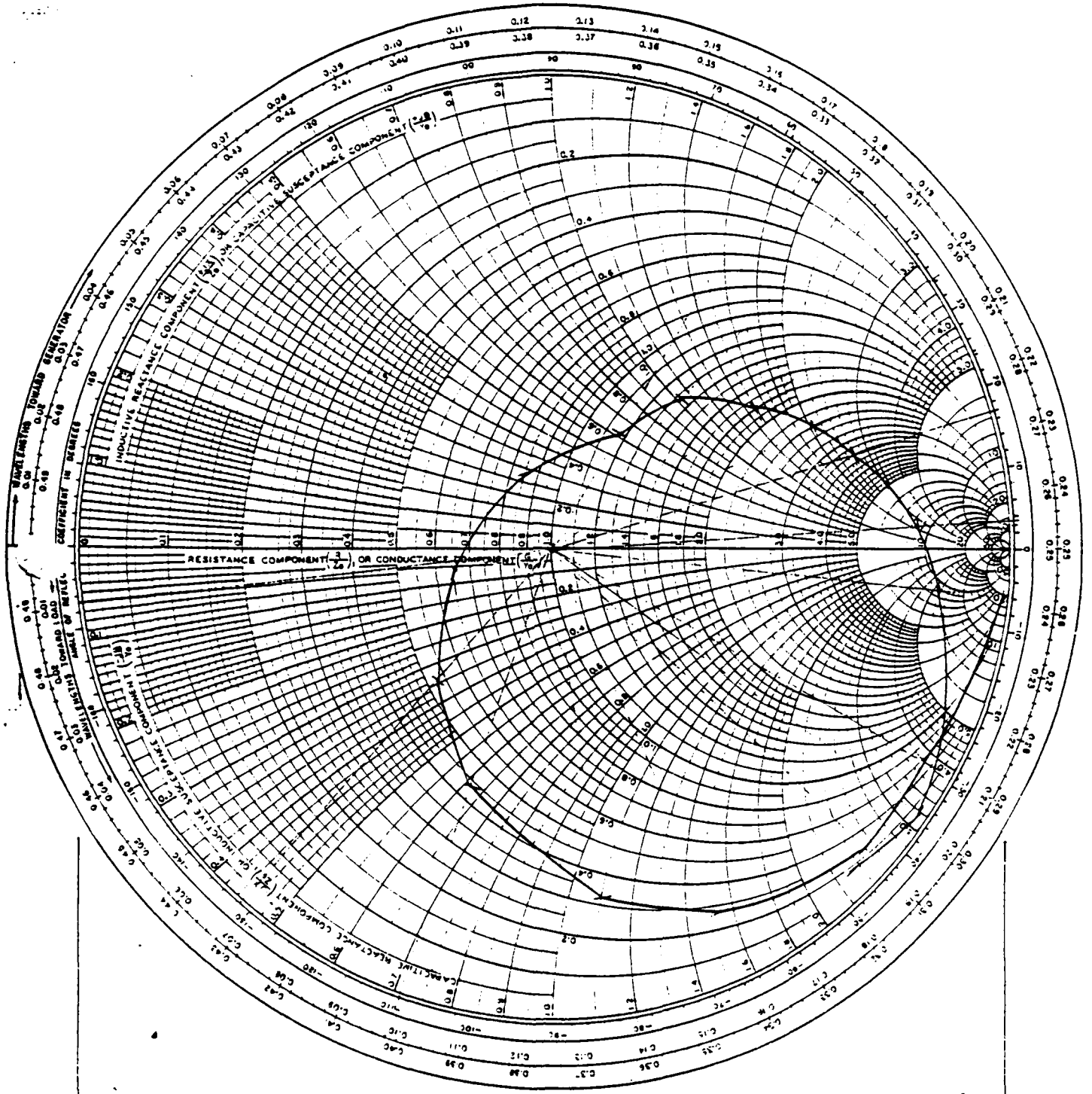
WITNESS: Amy Hudel N/A  
QC REP RAM 4 GOV'T REP

Lot #C

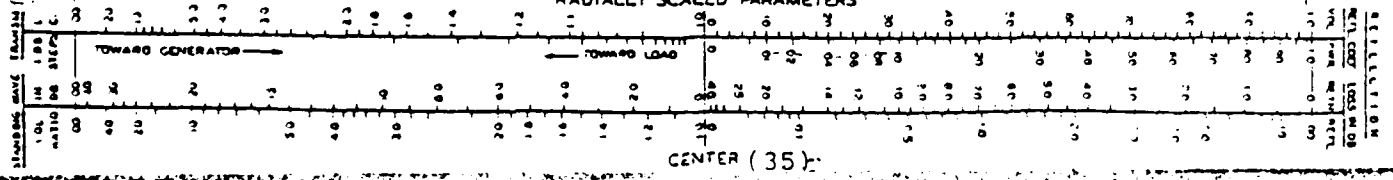
| S/N MS. 116 |        |        |       |         | S/N 57      |        |        |       |         |
|-------------|--------|--------|-------|---------|-------------|--------|--------|-------|---------|
| Freq. (MHz) | Z      | e      | Γ     | θ       | Freq. (MHz) | Z      | e      | Γ     | θ       |
| 2.0         | 953    | -89.6  | .9993 | -6.0    | 2.0         | 1.1Kr  | -89.6  | .9994 | -5.2    |
| 10.0        | 161    | -88.0  | .9804 | -34.5   | 10.0        | 199.3  | -88.78 | .8901 | -28.16  |
| 12.0        | 116.45 | -85.26 | .9409 | -46.39  | 12.0        | 154    | -87.50 | .9747 | -35.95  |
| 14.0        | 77.2   | -80.42 | .8581 | -65.55  | 14.0        | 117    | -85.92 | .9498 | -46.2   |
| 15.0        | 57.09  | -73.17 | .7442 | -82.10  | 15.0        | 99.21  | -84.01 | .9199 | -53.33  |
| 16.0        | 37.75  | -54.39 | .5311 | -109.25 | 16.0        | 81.35  | -80.92 | .8682 | -62.86  |
| 16.5        | 31.33  | -32.76 | .3722 | -131.81 | 16.5        | 72.10  | -78.10 | .8225 | -69.07  |
| 17.0        | 32.82  | -2.85  | .2089 | -173.1  | 17.0        | 62.75  | -73.6  | .7534 | -76.53  |
| 17.5        | 44.83  | +17.85 | .1665 | +109.56 | 17.5        | 54.57  | -66.17 | .6527 | -84.50  |
| 18.0        | 60.35  | +30.12 | .2853 | +69.42  | 18.0        | 47.21  | -56.94 | .5430 | -94.0   |
| 18.5        | 84.42  | +37.60 | .4240 | +48.17  | 18.5        | 41.01  | -40.28 | .3784 | -166.20 |
| 19.0        | 116.60 | +40.49 | .5360 | +34.15  | 19.0        | 48.44  | +2.2   | .0179 | -122.71 |
| 19.5        | 158.0  | +39.75 | .6225 | +24.24  | 19.5        | 40.76  | -18.84 | .1949 | +105    |
| 20.0        | 216.0  | +37.71 | .6950 | +16.57  | 20.0        | 64.34  | +18.81 | .2075 | +51.76  |
| 21.0        | 435.44 | +16.4  | .8019 | +3.17   | 21.0        | 141.2  | +30.94 | .5461 | +22.46  |
| 22.0        | 533    | -33.7  | .8554 | -6.0    | 22.0        | 305.2  | +12.12 | .7240 | +3.98   |
| 25.0        | 195    | -80.60 | .9261 | -28.48  | 25.0        | 199.8  | -78.06 | .9057 | -27.62  |
| 30.0        | 126.50 | -84.75 | .9392 | -43.02  | 30.0        | 125.53 | -84.53 | .9369 | -43.31  |

|                        |       |          |
|------------------------|-------|----------|
| NAME                   | TITLE | DWG. NO. |
| SMITH CHART Form 756-N |       | DATE     |

IMPEDANCE OR ADMITTANCE COORDINATES



RADIALLY SCALED PARAMETERS



CENTER (35)



POST HIGH TEMP  
PRE VIBRATION

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-17-87

TESTED

*Jim Clark*  
Jim Clark

S/N: D

WITNESSES

*Connie Lyles*  
Connie Lyles

N/A

QC REP

GOV'T REP

| ANTENNA<br>S/N | WITHSTOOD DIELECTRIC BREAKDOWN |       |
|----------------|--------------------------------|-------|
|                | YES                            | NO    |
| <u>61</u>      | <u>4.811A</u>                  | _____ |
| <u>62</u>      | <u>3.111A</u>                  | _____ |
| <u>63</u>      | <u>3.011A</u>                  | _____ |
| <u>64</u>      | <u>3.011A</u>                  | _____ |
| <u>65</u>      | <u>4.811A</u>                  | _____ |
| <u>66</u>      | <u>3.611A</u>                  | _____ |
| <u>67</u>      | <u>2.911A</u>                  | _____ |
| <u>68</u>      | <u>3.911A</u>                  | _____ |
| <u>69</u>      | <u>3.911A</u>                  | _____ |
| <u>70</u>      | <u>3.111A</u>                  | _____ |
| <u>71</u>      | <u>4.411A</u>                  | _____ |
| <u>72</u>      | <u>3.011A</u>                  | _____ |
| <u>73</u>      | <u>3.711A</u>                  | _____ |
| <u>74</u>      | <u>3.811A</u>                  | _____ |
| <u>75</u>      | <u>3.011A</u>                  | _____ |
| <u>76</u>      | <u>3.111A</u>                  | _____ |

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



POST HIGH TEMP  
PRE VIBRATION

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip

DATE: 6-18-87

TESTED BY Jim Clark

LOT D

WITNESS

Connie Lyles  
Connie Lyles

N/A

QC REP

GOV'T REP

| S/N            | Frequency of resonance in MHz | R Loss | VSWR |
|----------------|-------------------------------|--------|------|
| 61             | 19.7                          | 32     | 1.04 |
| 62             | 19.6                          | 30     | 1.06 |
| 63             | 19.7                          | 30     | 1.06 |
| 64             | 19.8                          | 32     | 1.04 |
| 65             | 19.9                          | 34     | 1.03 |
| 66             | 19.8                          | 33     | 1.03 |
| 67             | 19.9                          | 30     | 1.06 |
| 68             | 19.5                          | 30     | 1.06 |
| 69             | 19.8                          | 30     | 1.06 |
| 70             | 19.6                          | 30     | 1.06 |
| 71             | 19.7                          | 30     | 1.06 |
| 72             | 19.5                          | 28     | 1.08 |
| 73             | 20.                           | 33     | 1.03 |
| 74             | 19.7                          | 30     | 1.08 |
| 75             | 19.6                          | 30     | 1.08 |
| 76             | 19.7                          | 32     | 1.04 |
| 77             | 19.8                          | 32     | 1.04 |
| 78             | 19.8                          | 32     | 1.04 |
| 79             | 19.7                          | 32     | 1.04 |
| 80             | 19.6                          | 30     | 1.06 |
| Standard MS116 | 17.3                          | 24     | 1.13 |

PRODUCT TESTING LABORATORY TEST LOG

JCB NO. MO019 CUSTOMER Jim Clark P.O. NO. \_\_\_\_\_  
 TEST ENGINEER Jim Clark TEST TECH. \_\_\_\_\_ GSI/WITNESS \_\_\_\_\_  
 PRODUCT DESCRIPTION (Model No., Type, Ser. No., Quantity, Etc.) MS 116 HUPD Serial NO 61-80  
 TEST DESCRIPTION (Vib., Shock, Etc.) Vibration  
 TEST PROC. R.A. Miller Test Plan

|       | DATE    | TIME  | EVENT DESCRIPTION |
|-------|---------|-------|-------------------|
| Start | 6-18-87 | 10:00 | SN 72 At 55hz     |
| Stop  | 6-18-87 | 12:00 |                   |
| Start | 6-18-87 | 14:00 | SN 71 At 55hz     |
| Stop  | 6-18-87 | 16:00 |                   |
| Start | 6-18-87 | 16:03 | SN 63 At 53.5hz   |
| Stop  | 6-18-87 | 17:03 |                   |
| Start | 6-19-87 | 10:00 | SN 63 At 53.5hz   |
| Stop  | 6-19-87 | 11:00 |                   |
| Start | 6-19-87 | 11:10 | SN 65 At 52hz     |
| Stop  | 6-19-87 | 13:10 |                   |
| Start | 6-19-87 | 13:15 | SN 78 At 53hz     |
| Stop  | 6-19-87 | 15:15 |                   |
| Start | 6-19-87 | 15:18 | SN 60 At 52hz     |
| Stop  | 6-19-87 | 17:18 |                   |
| Start | 6-22-87 | 09:55 | SN 77 At 56hz     |
| Stop  | 6-22-87 | 11:55 |                   |
| Start | 6-22-87 | 11:55 | SN 77 At 56hz     |
| Stop  | 6-22-87 | 13:55 |                   |
| Start | 6-22-87 | 13:57 | SN 79 At 52.5hz   |
| Stop  | 6-22-87 | 15:57 |                   |
| Start | 6-22-87 | 15:57 | SN 67 At 5.5hz    |
| Stop  | 6-22-87 | 16:57 |                   |
| Start | 6-23-87 | 08:15 | SN 67 At 55hz     |
| Stop  | 6-23-87 | 09:15 |                   |
| Start | 6-23-87 | 09:15 | SN 80 At 54hz     |
| Stop  | 6-23-87 | 11:15 |                   |
| Start | 6-23-87 | 11:15 | SN 70 At 53.5hz   |
| Stop  | 6-23-87 | 13:15 |                   |
| Start | 6-23-87 | 13:15 | SN73 At 55hz      |
| Stop  | 6-23-87 | 15:15 |                   |

**PRODUCT TESTING LABORATORY TEST LOG**

JOB NO. M0019 CUSTOMER \_\_\_\_\_ P.O. NO. \_\_\_\_\_  
 TEST ENGINEER James Vantz TEST TECH. \_\_\_\_\_ GSI/WITNESS \_\_\_\_\_  
 PRODUCT DESCRIPTION (Model No., Type, Ser. No., Quantity, Etc.) MS 116 HUPD Serial No 61-80 Cont  
 TEST DESCRIPTION (Vib., Shock, Etc.) Vibration  
 TEST PROC. R.A. Miller Test Plan

|       | DATE    | TIME  | EVENT DESCRIPTION |
|-------|---------|-------|-------------------|
| Start | 6-23-87 | 15:15 | SN 64 At 53hz     |
| Stop  | 6-23-87 | 17:15 |                   |
| Start | 6-24-87 | 08:10 | SN 68 At 55hz     |
| Stop  | 6-24-87 | 10:10 |                   |
| Start | 6-24-87 | 10:10 | SN 61 At 55.5hz   |
| Stop  | 6-24-87 | 12:10 |                   |
| Start | 6-24-87 | 12:10 | SN 69 At 54.5hz   |
| Stop  | 6-24-87 | 14:10 |                   |
| Start | 6-24-87 | 14:10 | SN 74 At 53hz     |
| Stop  | 6-24-87 | 16:10 |                   |
| Start | 6-24-87 | 16:10 | SN 76 At 56hz     |
| Stop  | 6-24-87 | 17:00 |                   |
| Start | 6-25-87 | 08:10 | SN 76 At 56hz     |
| Stop  | 6-25-87 | 09:20 |                   |
| Start | 6-25-87 | 09:20 | SN 62 At 54hz     |
| Stop  | 6-25-87 | 11:20 |                   |
| Start |         |       |                   |
| Stop  |         |       |                   |
| Start |         |       |                   |
| Stop  |         |       |                   |
| Start |         |       |                   |
| Stop  |         |       |                   |
| Start |         |       |                   |
| Stop  |         |       |                   |
| Start |         |       |                   |
| Stop  |         |       |                   |
| Start |         |       |                   |
| Stop  |         |       |                   |

POST VIBRATION

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 7-1-87

TESTED BY: James Jantz

S/N: D

WITNESS: Amy Hudd Amy Hudd N/A  
QC REP GOV'T REP

RAM 4

| ANTENNA<br>S/N | WITHSTOOD DIELECTRIC BREAKDOWN |               |
|----------------|--------------------------------|---------------|
|                | YES                            | NO            |
| <u>61</u>      | <u>4.9 uA</u>                  | <u>      </u> |
| <u>62</u>      | <u>3.0 uA</u>                  | <u>      </u> |
| <u>63</u>      | <u>3.2 uA</u>                  | <u>      </u> |
| <u>64</u>      | <u>3.4 uA</u>                  | <u>      </u> |
| <u>65</u>      | <u>4.7 uA</u>                  | <u>      </u> |
| <u>66</u>      | <u>3.6 uA</u>                  | <u>      </u> |
| <u>67</u>      | <u>3.0 uA</u>                  | <u>      </u> |
| <u>68</u>      | <u>3.5 uA</u>                  | <u>      </u> |
| <u>69</u>      | <u>3.7 uA</u>                  | <u>      </u> |
| <u>70</u>      | <u>3.4 uA</u>                  | <u>      </u> |
| <u>71</u>      | <u>4.1 uA</u>                  | <u>      </u> |
| <u>72</u>      | <u>2.9 uA</u>                  | <u>      </u> |
| <u>73</u>      | <u>3.4 uA</u>                  | <u>      </u> |
| <u>74</u>      | <u>3.5 uA</u>                  | <u>      </u> |
| <u>75</u>      | <u>3.0 uA</u>                  | <u>      </u> |
| <u>76</u>      | <u>3.3 uA</u>                  | <u>      </u> |

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



POST VIBRATION  
VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot <sup>whsp</sup>

DATE: 7-1-87

TESTED BY *Ed Eisenheimer*

WITNESS *Connie Lyles*  
 QC REP

N/A  
 GOV'T REP

| S/N       | Frequency of resonance in MHz | R Loss | VSWR |
|-----------|-------------------------------|--------|------|
| 61        | 19.8                          | 18     | 1.28 |
| 62        | 19.7                          | 20     | 1.22 |
| 63        | 19.8                          | 19     | 1.25 |
| 64        | 19.5                          | 19     | 1.24 |
| 65        | 19.9                          | 19     | 1.24 |
| 66        | 19.9                          | 19     | 1.24 |
| 67        | 20.                           | 19     | 1.24 |
| 68        | 19.8                          | 19     | 1.25 |
| 69        | 19.8                          | 21     | 1.20 |
| 70        | 19.8                          | 19     | 1.24 |
| 71        | 19.8                          | 19.5   | 1.24 |
| 72        | 19.7                          | 18.5   | 1.27 |
| 73        | 19.8                          | 20     | 1.22 |
| 74        | 19.8                          | 19     | 1.25 |
| 75        | 19.9                          | 21     | 1.18 |
| 76        | 19.9                          | 20     | 1.22 |
| 77        | 19.9                          | 20     | 1.22 |
| 78        | 19.9                          | 21     | 1.20 |
| 79        | 19.8                          | 19     | 1.25 |
| 80        | 19.7                          | 19     | 1.25 |
| MS-116 rd | 17.3                          | 22     | 1.04 |



*American Electronic Laboratories, Inc.*

June 30, 1987

R.A. Miller Industries, Inc.  
P.O. Box 858  
Grand Haven, MI 49417

Attention: Mr. Jim Clark                      Test Report No. 88-236-8205

Reference: R. A. Miller P. O. No. 9646

Gentlemen:

This report certifies the performance of Ballistic Shock testing on twenty (20) 15' Whip Antennas, P/N MS-116 HUPU, S/Nos. 81 thru 100, submitted by R. A. Miller Industries, Inc. The test was conducted in accordance with MIL-S-901, Grade A, Type A, Class 1. Four base mount assemblies and four standard MS-116 Whips (2 MS-116, 1 MS-117, 1 MS-118 per unit) were used repeatedly for the test.

The top section (MS-118) of each antenna was removed and taped 15" lower to the section below it (MS-117) to allow for ceiling clearance.

A visual inspection of the test specimens at the completion of the shock exposure revealed no anomalies due to testing. One base mount assembly was found cracked as a result of testing. All post shock tests are to be performed at R. A. Miller. A copy of the Test Logs and an Equipment List are included in this report.

The test was conducted at the AEL Product Testing Laboratory, Richardson Road, Lansdale, PA 19446. The test specimens were returned to R. A. Miller after completion of testing on June 23, 1987.

Very truly yours,

AMERICAN ELECTRONIC LABORATORIES, INC.

P. M. Spackman, Test Engineer  
Product Testing Laboratory

FMS:rb  
Enc.

EQUIPMENT LIST

| <u>EQUIPMENT</u>                             | <u>MANUFACTURER</u>    | <u>MODEL NO.</u> | <u>AEL NO.</u> | <u>CAL DUE DATE</u> |
|--|------------------------|------------------|----------------|---------------------|
| Light Weight High<br>Impact Shock<br>Machine | New England<br>Trawler | MIL-S-901        | 8944           | Each Use            |

The above equipment has been calibrated by standards which are regularly calibrated and whose accuracies are traceable to the National Bureau of Standards.

Report No. 88-236-8205

Page 1 of 1 page



**American Electronic Laboratories, Inc.**  
A Subsidiary of AEL Industries, Inc.



PRODUCT TESTING LABORATORY TEST LOG

JOB NO. 17525-8205 CUSTOMER R.A. Miller Inc P.O. NO. 9646  
 TEST ENGINEER PNB TEST TECH. AP GSI/WITNESS \_\_\_\_\_  
 PRODUCT DESCRIPTION (Model No., Type, Ser. No., Quantity, Etc.) 20 - MS-116 HVPU  
Section of MS-116 15' whip antenna 9/181 to 100  
 TEST DESCRIPTION (Vib., Shock, Etc.) Shock  
 TEST PROC. Mil-S-901 Grade A Type A class 1

| DATE    | TIME | EVENT DESCRIPTION   |   |   |   |      |
|---------|------|---|---|---|---|------|
| 6/23/87 |      | Place fixture on shock machine.<br>Base and other sections on antenna will be used in shock test, only MS-116 HVPU will be changed each time. |   |   |   |      |
|         | 1000 | Start shock   |   |   |   |      |
|         |      | S/M   | X | Y | Z | Axis |
|         |      | 81  | ✓ | ✓ | ✓ |      |
|         |      | 82  | ✓ | ✓ | ✓ |      |
|         |      | 83  | ✓ | ✓ | ✓ |      |
|         |      | 84  | ✓ | ✓ | ✓ |      |
|         |      | 85  | ✓ | ✓ | ✓ |      |
|         |      | 86  | ✓ | ✓ | ✓ |      |
|         |      | 87  | ✓ | ✓ | ✓ |      |
|         |      | 88  | ✓ | ✓ | ✓ |      |
|         |      | 89  | ✓ | ✓ | ✓ |      |
|         |      | 90  | ✓ | ✓ | ✓ |      |
|         |      | 91  | ✓ | ✓ | ✓ |      |
|         |      | 92  | ✓ | ✓ | ✓ |      |
|         |      | 93  | ✓ | ✓ | ✓ |      |
|         |      | 94  | ✓ | ✓ | ✓ |      |
|         |      | 95  | ✓ | ✓ | ✓ |      |
|         |      | 96  | ✓ | ✓ | ✓ |      |
|         |      | 97  | ✓ | ✓ | ✓ |      |
|         |      | 98  | ✓ | ✓ | ✓ |      |
|         |      | 99  | ✓ | ✓ | ✓ |      |
|         |      | 100   | ✓ | ✓ | ✓ |      |
|         | 1500 | End of shock test, on mounting base<br><del>insulator</del> insulator has crack in it.<br>No apparent damage done to MS-116 HVPU              |   |   |   |      |

POST BALLISTIC SHOCK

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 7-1-87

TESTED BY: *James Jantz*  
James Jantz

S/N: E

WITNESS: *Connie Lyles*  
Connie Lyles

QC REP N/A  
GOV'T REP

ANTENNA  
S/N

WITHSTOOD DIELECTRIC BREAKDOWN  
YES NO

| ANTENNA S/N | WITHSTOOD DIELECTRIC BREAKDOWN | YES          | NO           |
|-------------|--------------------------------|--------------|--------------|
| <u>81</u>   | <u>2.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>82</u>   | <u>2.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>83</u>   | <u>2.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>84</u>   | <u>3.5 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>85</u>   | <u>3.9 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>86</u>   | <u>4.0 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>87</u>   | <u>2.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>88</u>   | <u>2.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>89</u>   | <u>2.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>90</u>   | <u>3.4 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>91</u>   | <u>2.7 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>92</u>   | <u>4.4 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>93</u>   | <u>3.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>94</u>   | <u>2.6 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>95</u>   | <u>2.7 uA</u>                  | <u>_____</u> | <u>_____</u> |
| <u>96</u>   | <u>2.5 uA</u>                  | <u>_____</u> | <u>_____</u> |

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



POST BALLISTIC  
VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip

DATE: 7-1-87

TESTED BY ED Eisenheimer

3 WVE

*Connie Lyles*

WITNESS Connie Lyles

N/A

QC REP

GOV'T REP

| S/N             | Frequency of resonance in MHz | R Loss | VSWR |
|-----------------|-------------------------------|--------|------|
| 81              | 21.                           | 20     | 1.20 |
| 82              | 19.5                          | 20     | 1.25 |
| 83              | 19.8                          | 24     | 1.13 |
| 84              | 19.9                          | 21     | 1.20 |
| 85              | 19.8                          | 20     | 1.22 |
| 86              | 19.8                          | 20     | 1.22 |
| 87              | 20.                           | 20     | 1.22 |
| 88              | 19.9                          | 19     | 1.25 |
| 89              | 19.9                          | 20     | 1.21 |
| 90              | 19.7                          | 20     | 1.22 |
| 91              | 19.9                          | 19     | 1.25 |
| 92              | 19.8                          | 19     | 1.24 |
| 93              | 20                            | 22     | 1.17 |
| 94              | 19.8                          | 19     | 1.24 |
| 95              | 19.9                          | 21     | 1.20 |
| 96              | 19.7                          | 22     | 1.17 |
| 97              | 19.8                          | 21     | 1.20 |
| 98              | 20.                           | 19     | 1.25 |
| 99              | 19.8                          | 19     | 1.24 |
| 100             | 19.9                          | 20     | 1.22 |
| Standard MS 116 | 17.3                          | 22     | 1.04 |

END

9-87

Dtic