AD604479

31 AUG 1964

USAEL Technical Documents Center
Hexagon.
86025

USAELRDL Technical Report 2421

ASSEMBLY DESIGN OF MINIATURE LIGHTWEIGHT HANDHELD RADAR SET AN/PPS-6

by

HARRY H. FRENCH

SEPTEMBER 1963

UNITED STATES ARMY
ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORIES
FORT MONMOUTH, N.J.

U. S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORIES

FORT MONMOUTH, NEW JERSEY

19 March 1964

USAELRDL Technical Report 2421 has been prepared under the supervision of the Director, Electronic Components Department, and is published for the information and guidance of all concerned. Suggestions or criticisms relative to the form, content, purpose, or use of this publication should be referred to the Commanding Officer, U. S. Army Electronics Research and Development Laboratories, Attn: Modular Assemblies Branch, Electronic Parts and Materials Division, Fort Monmouth, New Jersey.

FOR THE COMMANDER:

B. B. Palmer
B. B. PALMER
Major, WAC
Adjutant

DISTRIBUTION:
Special

QUALIFIED REQUESTERS MAY OBTAIN COPIES OF THIS REPORT FROM DDC.

THIS REPORT HAS BEEN RELEASED TO THE OFFICE OF TECHNICAL SERVICES, U. S. DEPARTMENT OF COMMERCE, WASHINGTON 25, D. C., FOR SALE TO THE GENERAL PUBLIC.

ASSEMBLY DESIGN OF MINIATURE LIGHTWEIGHT HANDHELD
RADAR SET AN/PPS-6

Harry H. French

DA Task Nr. 50-58-05-001-05
DA Task Nr. 3A99-15-002-03

Abstract

This report covers in-house work of the Modular Assemblies Branch, Electronic Parts and Materials Division, to provide two modularized, printed wiring models of the (Mark IV) Lightweight Handheld Radar Set (AN/PPS-6).

The initial model included packaging design using the latest state-of-the-art techniques for miniaturized, lightweight, ruggedized, electronic modules to meet test and operational requirements initially stipulated by the Radar Division, USAELRDL. The second model was designed to contain additional temperature-compensating circuits to further miniaturize the equipment, and to modify the package design for greater ease of maintenance.

U. S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORIES
FORT MONMOUTH, NEW JERSEY

86025
USAEL Technical Documents Center
Hexagon.

CONTENTS

FIGURES

CONTENTS

FIGURES (Cont)

APPENDIXES

CONTENTS

FIGURES (Cont)

APPENDICES

ASSEMBLY DESIGN OF MINIATURE LIGHTWEIGHT HANDHELD
RADAR SET AN/PPS-6

PURPOSE

The Mark IV Radar Set (AN/PPS-6) assembly design task was undertaken as an in-house effort by the Equipment Integration Area, Modular Assemblies Branch, to provide an exploratory application of the latest state-of-the-art assembly techniques to the design of miniaturized radar equipment.

BACKGROUND

The Radar Division, Surveillance Department, as part of its internal work, had designed the transistor circuitry for a low voltage, pulse doppler radar set operating in the X-band for detection of moving targets at a range of up to 2000 meters.

Several handwired breadboard models were subsequently made by Radar Division to determine the design feasibility of a small handheld radar set. A size not to exceed the handwired models, a maximum weight of 15 pounds, and ease of maintenance were prime requisites for the Modular Assemblies Branch effort. The selected modular approach offered the following: (a) Size and weight reduction through higher packaging density; (b) Plug-in expendable subassemblies for ease of maintenance; (c) Exact duplication of critical circuits in repeat constructions by utilizing printed wiring techniques; and (d) Manufacturing cost reduction inherent in the use of modular and printed wiring approaches.

APPROACH

It was initially established that rectangular packages of modular construction were preferred and that circuit functions such as i.f., trigger generator, etc., should be confined to individual modules. A circuit with the greatest component density (box car buffer & audio) was chosen to establish standard modular dimensions. Circuitry was designed to occupy a minimum area consistent with good layout design principles as described in Signal Corps Technical Requirements No. SCL-6225, "Design Requirements for Auto-Sembled Signal Electronic Equipment," dated 10 July 1957. These dimensions were then used as a standard for most other circuit modules.

The "modulator" and "power supply" modules were designed in a different form factor because of the large physical size of the component parts required in these stages.

INITIAL DESIGN

Component Part Selection

Military-approved component parts, recommended by Electronic Parts and Materials Division specialists, were used for the Mark IV wherever practicable. Miniaturized component parts were used wherever tolerances and voltages would permit. Selection of the microwave components was coordinated between personnel of the Radar Division and microwave design personnel of

Electronic Parts and Materials Division.

The initial package design of the Mark IV was limited by the length of the cathode-ray tube (Fig. 1) and the configuration of the microwave components (Fig. 2).

Design Requirements and Considerations

Design requirements stipulated that the configuration of the Mark IV should be rectangular in shape and the equipment should be composed of two packages: a separately packaged aural radar set, and the "A" scope package containing the video portion of the Mark IV.

Further analysis of the schematic was made and each stage was designed to conform with the 1-5/8" x 5-1/4" card dimensions established as a limited standard for this model. (Redesign of these card layouts was necessary in Model 2 to include additional temperature-compensating circuits.)

Extreme care was required in layout design of circuits such as the high gain i.f. The design eliminated ground loops and interaction between adjacent circuits and provided short lead lengths and effective shielding. The printed-wired i.f. amplifiers produced identical waveforms to those of the initial breadboard model.

Standardized Modular Packages

Each stage designed on the standard-size card was encased in a two-piece-rectangular aluminum container. Tapped studs attached to each card provided a means of spacing and fastening the card to the base of the container. The end structure of each base supported a miniature plug and coaxial connectors for circuit connections. The container cover was designed as a slip-on type for ease of maintenance (Fig. 3). The modulator and power supply although larger in size than the standard card also had this slip-on feature.

Design of the various subassemblies in uniform-size modules provided circuit building blocks which consumed a minimum of space.

Human Factors

Consideration was given to the "human factor" element for convenient video and meter display, and for access to all necessary video and radar controls. In actual use of the first model, it was discovered that controls which were placed in positions that seemed proper in the panel design needed little or no adjustments during operation due to the excellent stability of the radar set. These controls were removed from the front panel in the second model and placed in accessible positions inside the chassis.

EQUIPMENT ASSEMBLY

Model 1

In accordance with Radar Division requirements, a rectangular frame was designed to contain all of the Mark IV module subassemblies. The depth of the frame was restricted to the depth dictated by the 9-1/2" length of the

CRT and the "A" scope package. The open frame was designed as a wraparound container strengthened by shelf-forming crossmembers and right-angle frame bends. The shelf-forming crossmembers provided suitable support and also served as receptacles for the subassembly modules and power supply (Fig. 4). All essential controls were mounted on the equipment panel and integration of the panel and the modules was made through plug-terminated cables.

The microwave assembly was mounted at the bottom of the module shelf and the center of the front-end cover. A slip-on dust cover was designed to slide over the frame and rigidly hold all subassemblies (Fig. 5). The back edge flange of the dust cover engaged the panel and the front edge terminated and fastened to the front cover with latches. The "A" scope package was designed in a similar manner, and fastened to the top of the radar set by means of four latches (Fig. 6). Interconnections between the "A" scope and the radar set were made through retractable connectors. The retractable feature was designed into the connector to permit cover removal and to provide a means of storing the connector when the "A" scope package is not desired.

Model 2

During design of Model No. 1, it became apparent that improvements would be desirable in a number of areas; however, the short delivery schedule precluded the use of all but incremental modifications until the effort on Model 2 was initiated.

In Model 1 the slip-on case had to be removed from both the "A" scope and the radar set in order to make any internal measurements or adjustments (Fig. 7). The dust cover was not of a rigid design. The circuits of Model 1 were not temperature-compensated. The size of Model 1 could be reduced by modifying the power supply and the microwave plumbing. The size of Model 2 was also restricted by the length of the CRT; however, redesign and repositioning of the microwave plumbing provided better utilization of space. The different configuration of the waveguide allowed the radar set to be lower than Model 1, but made the unit wider (Fig. 8). The redesign of the power supply to contain the entire circuit on one card (Fig. 9), rather than on four plug-in cards (Fig. 10), reduced the power supply volume by one-half. Redesign of the modulator (Fig. 11) resulted in a slightly smaller subassembly.

The design of Model 2 emphasized accessibility (Fig. 12). The rectangular package was designed of 1/16" aluminum for rigidity and strength. The package configuration was designed to have the width dimension greater than the height. The wide dimension was compatible with the new waveguide configuration, provided adequate room for the subassemblies and receptacles, and provided sufficient width to contain the 8-cell battery.

Hinged, door-like ends were designed for the package. The control panel and its component parts were mounted on one door and the microwave assembly was mounted on the other door (Fig. 8). Each door was hinged and secured by a latch. A battery compartment was designed behind the panel door and access to it is made by opening the panel door (Fig. 13). The sides of the case were designed with hinged panels. Racks were designed to hold the power supply modulator and subassembly modules. The subassemblies were inserted through the left-side panel door opening (Fig. 8) and electrically connected through connectors to rigidly mounted receptacles (Fig. 12). All shielded and pulse signals were fed through coaxial leads. The "A" scope assembly was joined to the top side of the radar set by four DZUS* fasteners and electrically connected by a rigidly mounted connector. The "A" scope contained had a hinged cover that could be opened for adjustment or test purposes (Fig. 14). The circuitry for the "A" scope was designed on two printed wiring boards which were mounted in the container behind and on one side of the CRT. The "A" scope unit was provided with a folding visor and a spare parts container (Fig. 15).

EVALUATION AND TEST

Evaluation and test data for each subassembly are contained in Electronic Parts and Assemblies Branch Test Reports (see Appendix).

RESULTS

Each individual subassembly, the microwave receiver and transmitter assembly, and the packaged Mark IV radar set operated satisfactorily and met all of the electrical requirements (Fig. 7). In addition, Model 1 was smaller and lighter in weight than the handwired radar set and any comparable set heretofore made. Model 2 was slightly larger than Model 1 and contained temperature-compensating circuits and the battery power source. The improvements made in Model 2 provide accessibility to all modules, panel connections, microwave assembly, and the "A" scope while the radar set is in operation.

The weight of the aural presentation package (Model 1) is 6 lbs 13 ozs; dimensions are 6-5/8" x 5-1/2" x 9-5/8". The 10-oz weight of the antenna and the 4-lb battery pack brought the overall weight of the radar set to 13 lbs 7 ozs. Inasmuch as Model 2 contains its own power source, this model contains a packaging advantage over Model 1. Model 2 weighs 11 lbs 11 ozs, less the 4-lb battery supply. The 2-lb 4-oz weight increase of Model 2 provides a ruggedized equipment with many desirable features not found in Model 1. The dimensions of Model 2 are 7-1/2" x 6-1/2" x 10-1/2", approximately the same size as the previous model (Fig. 16).

DISCUSSION

The packaging approach taken by the Modular Assemblies Branch has met the requirements stipulated by the Radar Division. The packaged assembly is smaller and lighter than the handwired feasibility models. In the course of designing the Model 1 package, a number of packaging ideas were developed which could further improve the assembly design. Freedom of package design in Model 2 permitted the application of techniques that could not be followed in the "frozen" design of Model 1. The power supply of Model 1 was designed with individual circuits on plug-in cards for maximum maintainability. (Transformer failure, for example, could be overcome simply by removing the transformer card and inserting a replacement.) The redesign of the entire power supply as an expendable module in Model 2 resulted in a supply one-half the size of that of Model 1.

The configuration of the microwave assembly of Model 1 was not compatible with the improved volumetric efficiency desired in Model 2. A partial reduction of the microwave package volume was accomplished by modification of the

*Trade name

magnetron adaptor from a female to a male BNC* connector. This approach permitted the magnetron to be attached directly to the adaptor in a vertical position, thus saving depth and eliminating the use of an additional connector.

Redesign of the microwave plumbing in Model 2 provided a wraparound waveguide with one-third the depth of Model 1.

The repackaging of the modulator of Model 2 reduced the overall module size slightly. The combination of changes in the microwave configuration and the reduction of the modulator and power supply permitted the radar set to be redesigned as a complete equipment.

CONCLUSIONS

Modular printed wiring assembly techniques have been shown to be readily adaptable to the construction and operational requirements of lightweight radar equipment of the general AN/PPS-6 family.

RECOMMENDATIONS

Redesign of Model 2, in which the battery supply is eliminated as part of the equipment, could further reduce the size of the radar set.

In operation, it is understoood that the "A" scope has proved to be an essential part of the set. The feature of a separate aural radar set could be discarded and the "A" scope could be contained as an integral part of the set.

Further design in the microwave area should be explored. The use of stripline techniques could further reduce size, weight and cost of this assembly.

The use of a smaller CRT with proper optical assistance would reduce the "A" scope dimensions.

The use of micromodules in those low-level circuits compatible to their usage would permit further size reduction.

ACKNOWLEDGMENTS

1. The work was a combined effort by the following personnel of the Equipment Integration Technical Area, Modular Assemblies Branch:

Organization and Supervision:	Norman Bechtold
Equipment Design and Layout:	Harry French & Victor Mechura
Test, Debugging & Operation:	George Hrivnak & James Van Dover

2. Acknowledgment is made to personnel of the following USAELRDL activities for assistance in the completion of this task: Electronic Parts and Materials Division which provided guidance in the selection of component parts and the compact microwave designs; Engineering and Drafting Branch, which prepared complete engineering drawings; and the Fabrication Division, which provided the sheet metal fabrication.

*Trade name

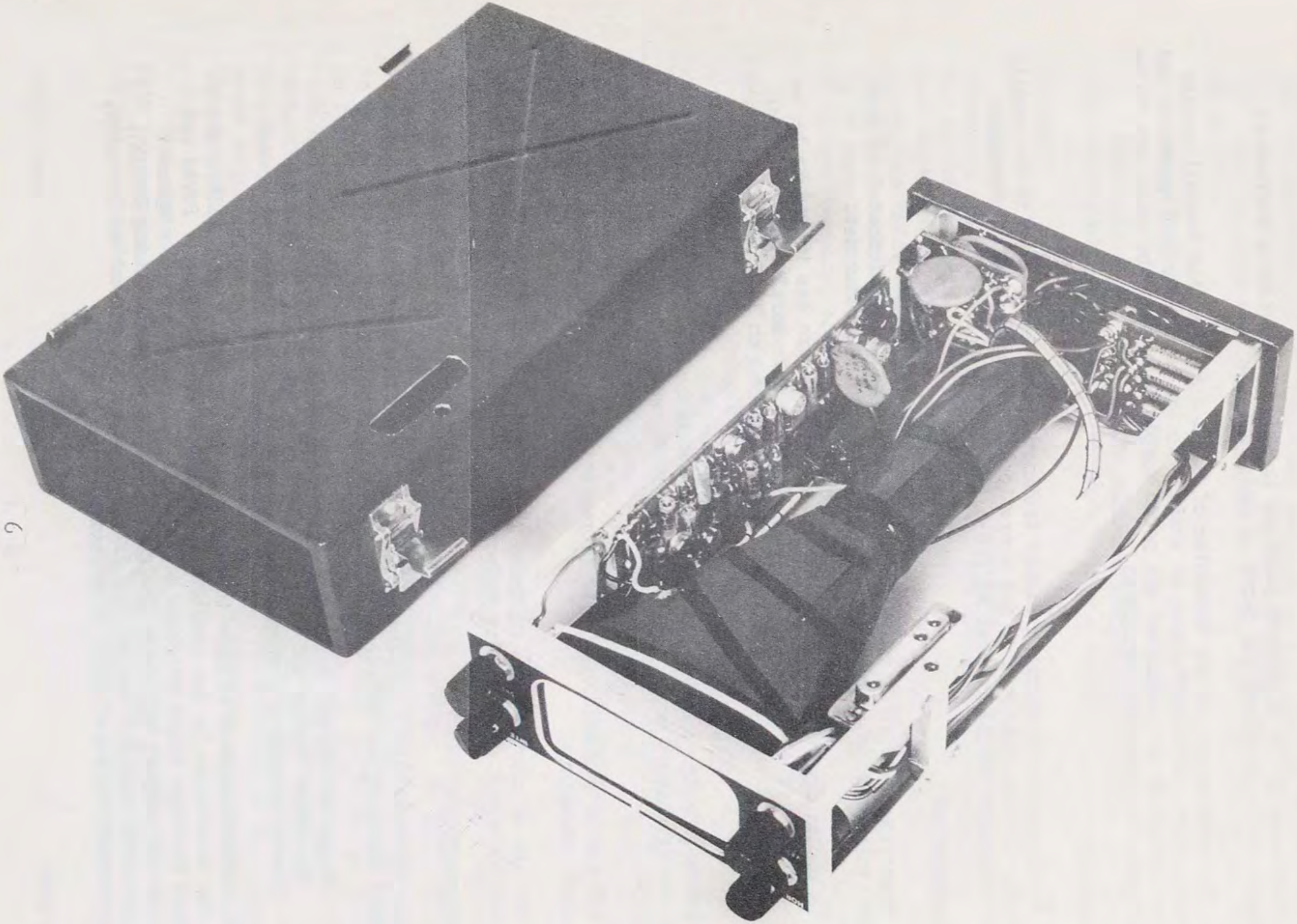


Fig. 1 Lightweight, Handheld Radar, Model 1. Group View Showing "A" Scope with Cover Removed

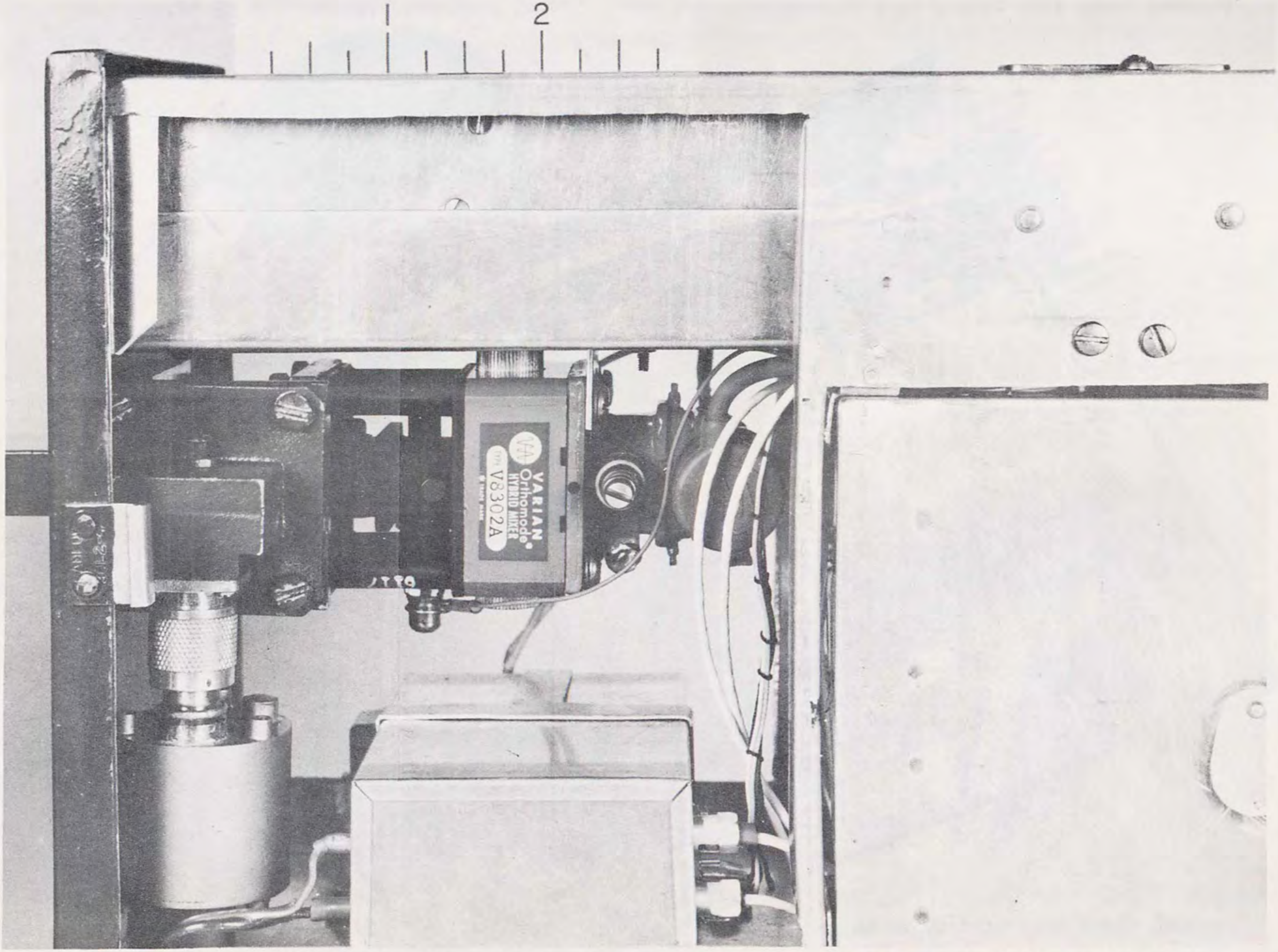


Fig. 2 Lightweight, Handheld Radar, Model 1. Closeup View Showing Microwave Assembly and Modulator

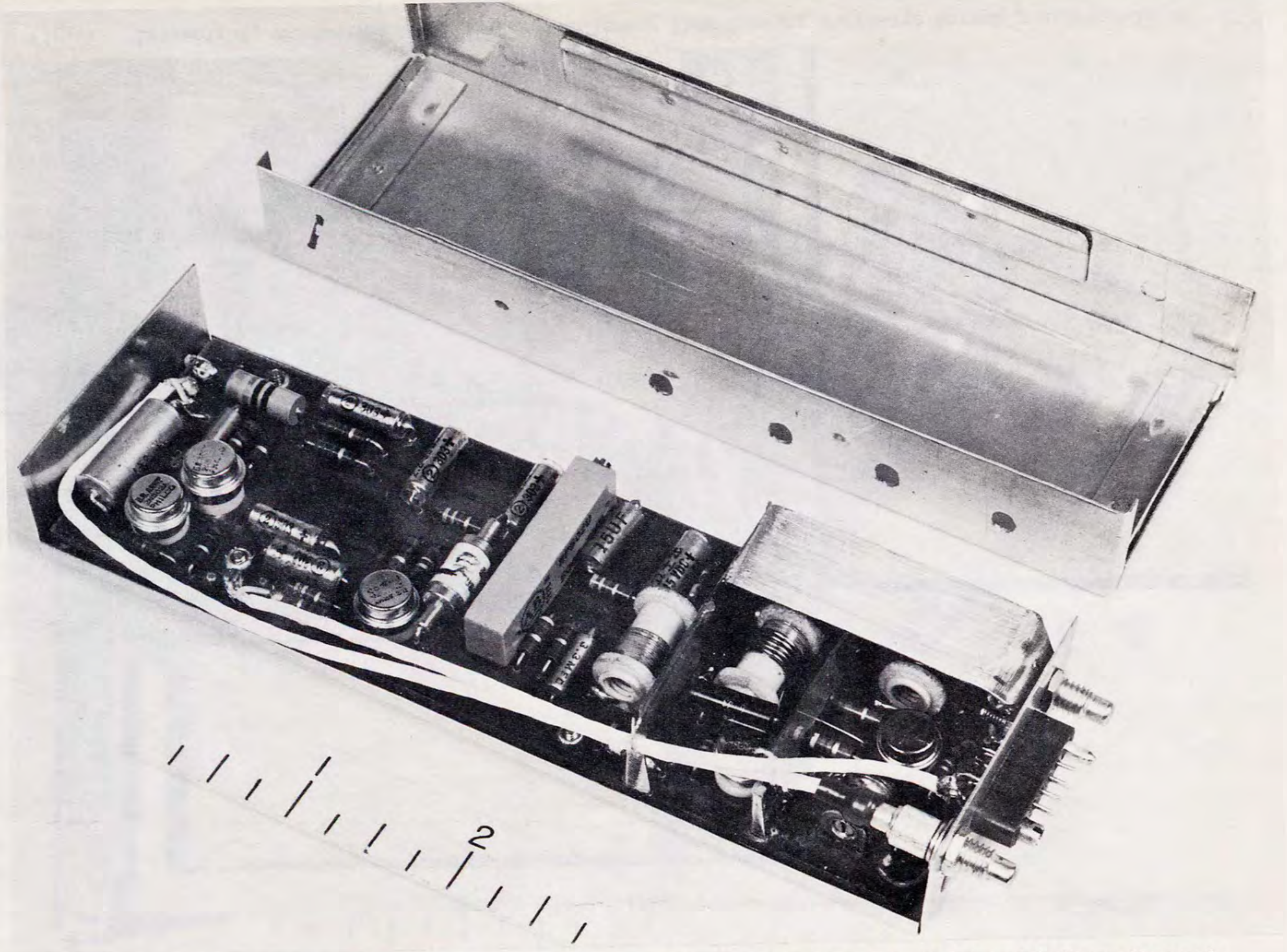


Fig. 3 Lightweight, Handheld Radar. Side 3/4 View Showing I.F. Module with Cover Removed

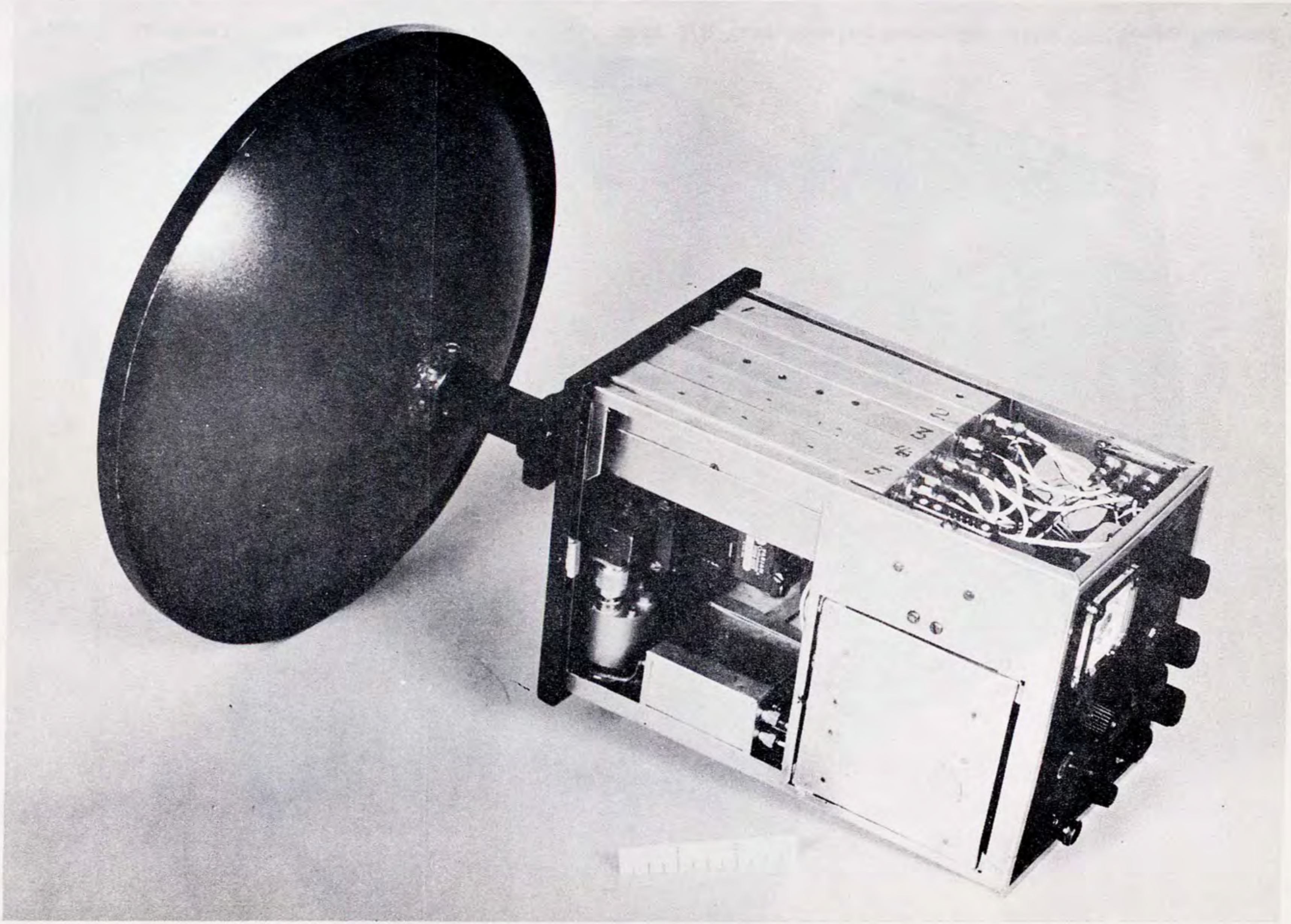


Fig. 4 Lightweight, Handheld Radar, Model 1. Rear 3/4 View Showing Radar Package with Cover Removed

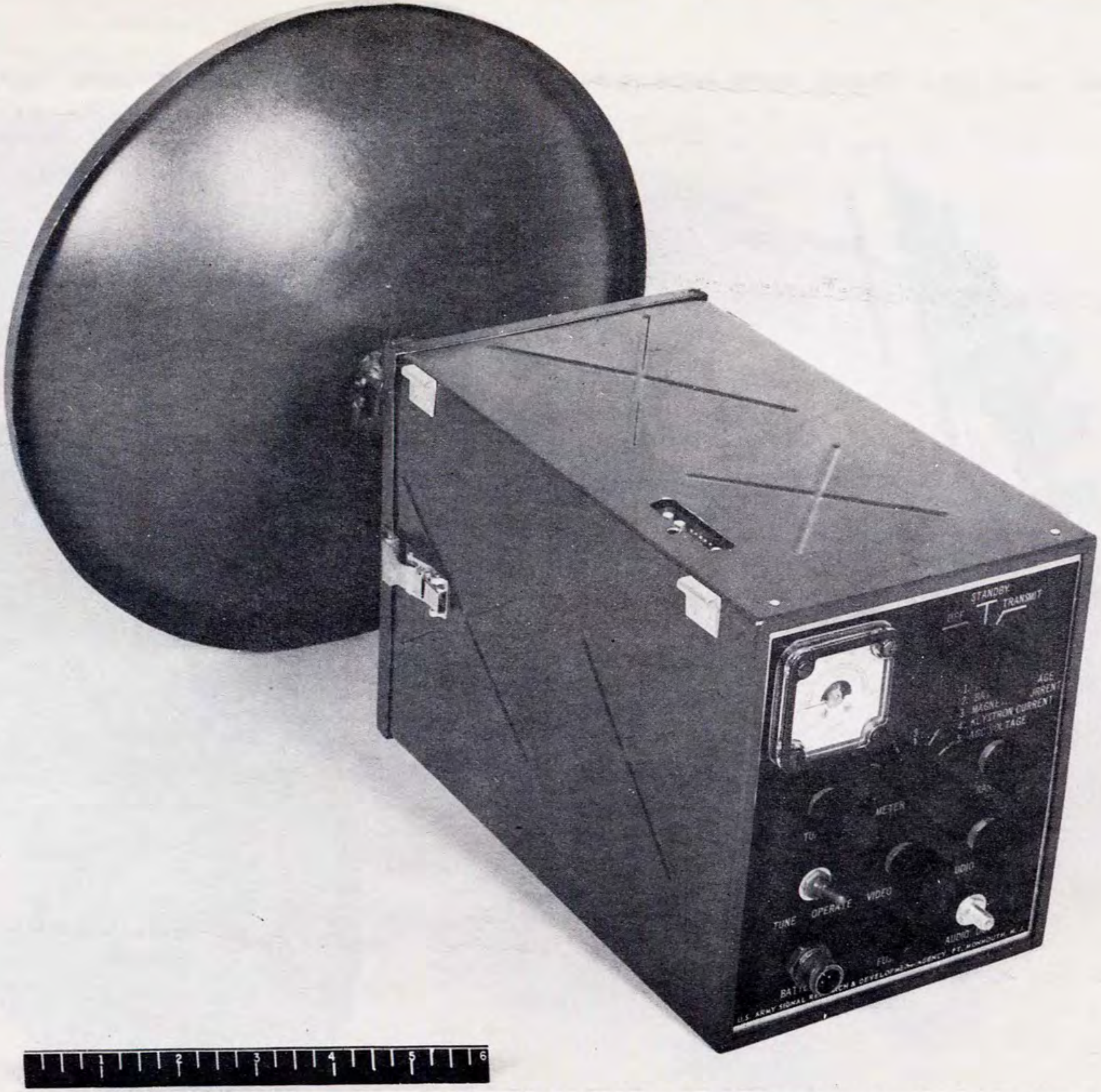


Fig. 5 Lightweight, Handheld Radar, Model 1. Rear 3/4 View Showing Radar Set with "A" Scope Removed

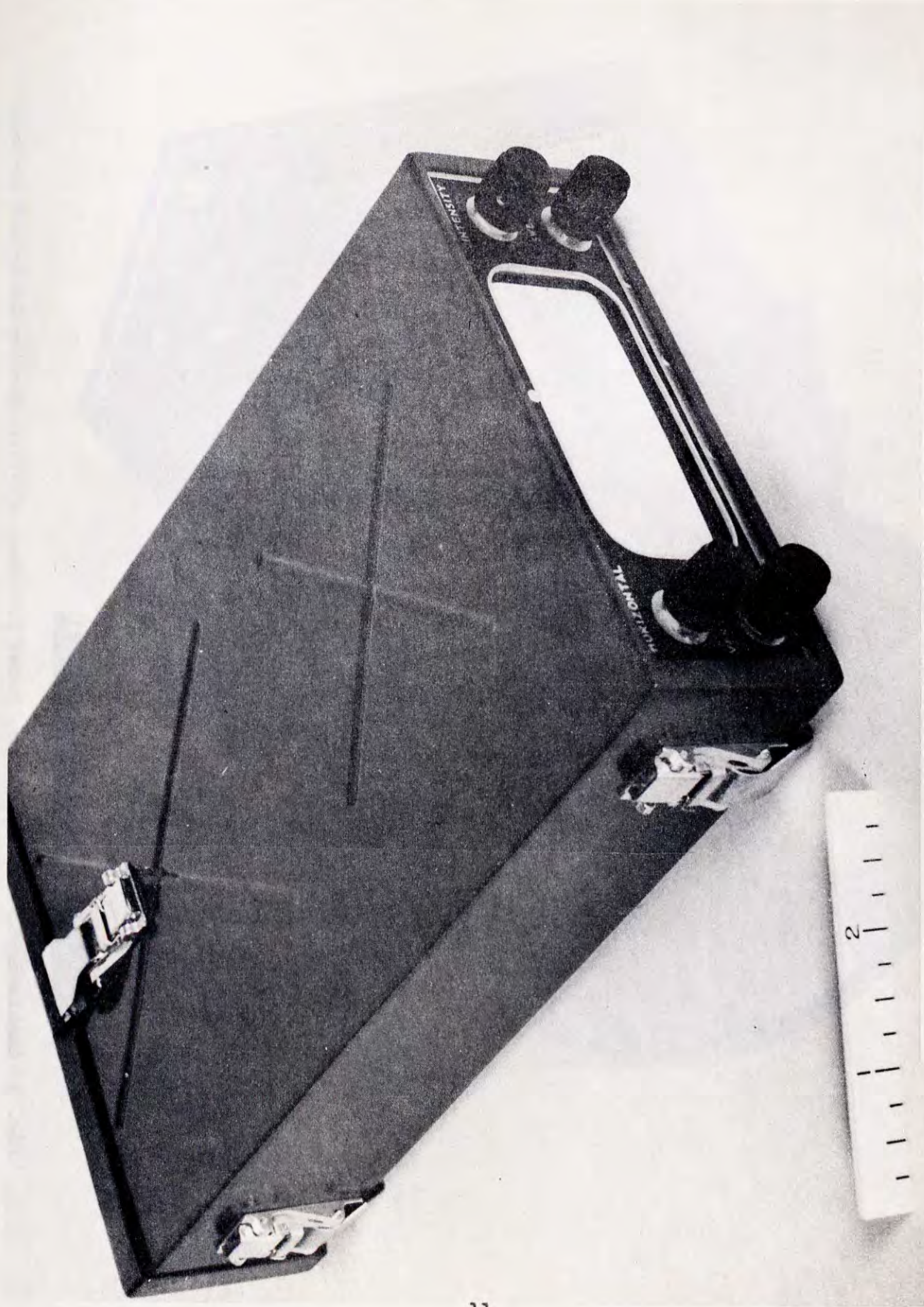


Fig. 6 AN/PPS-6, "A" Scope, Model 1

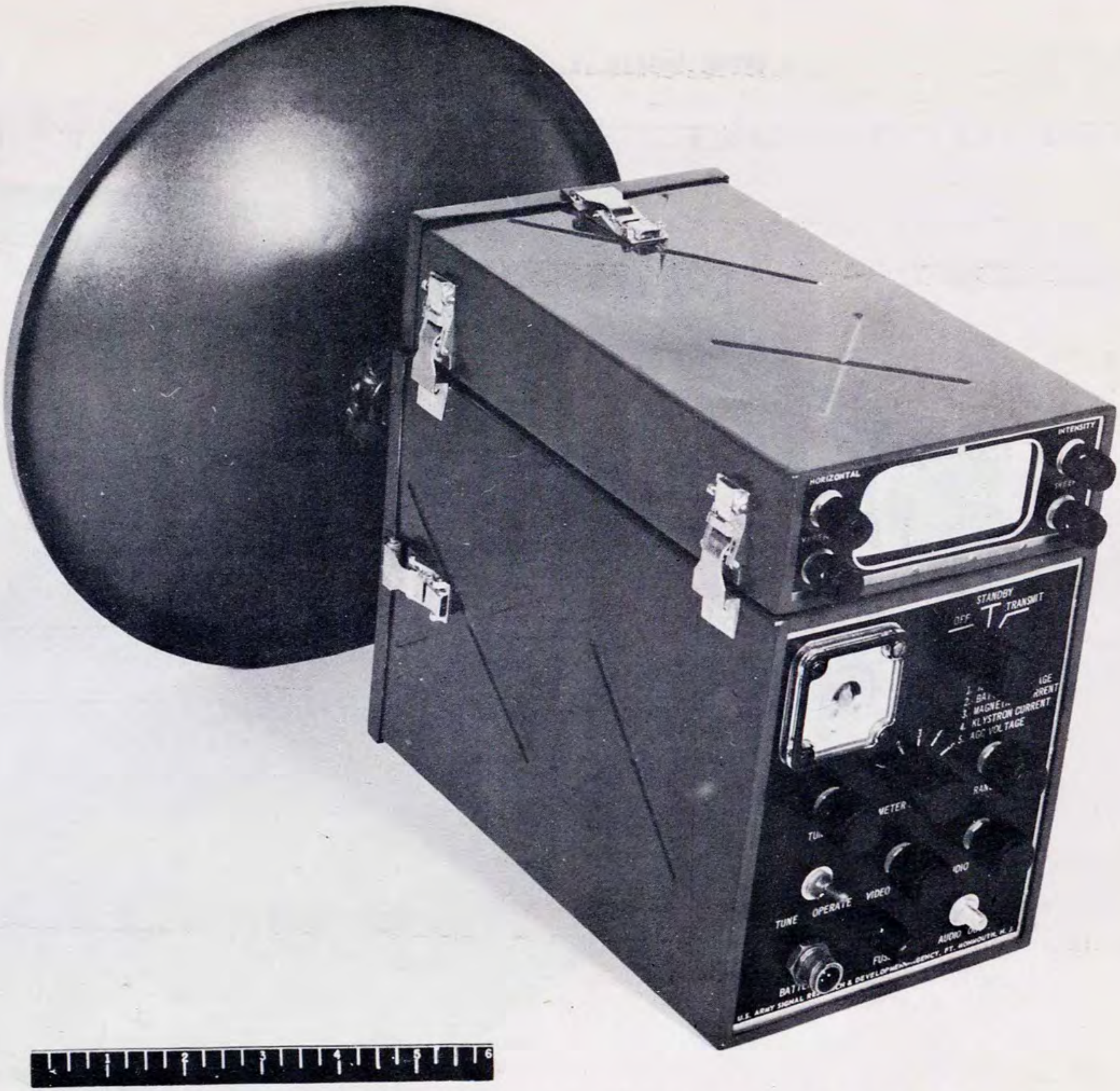


Fig. 7 Lightweight, Handheld Radar, Model 1. Rear 3/4 View Showing Assembled Package

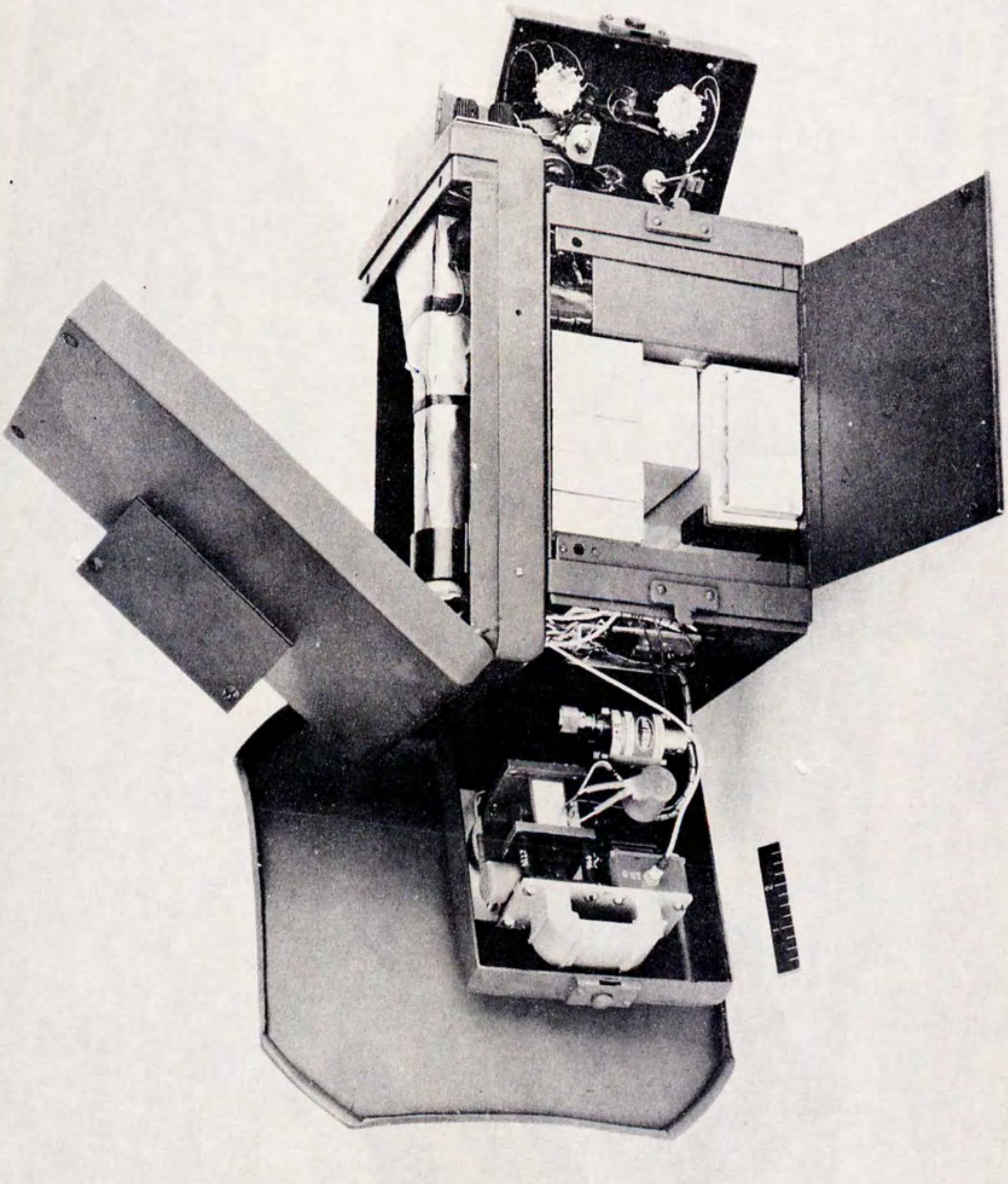


Fig. 8 AN/PPS-6, Model 2

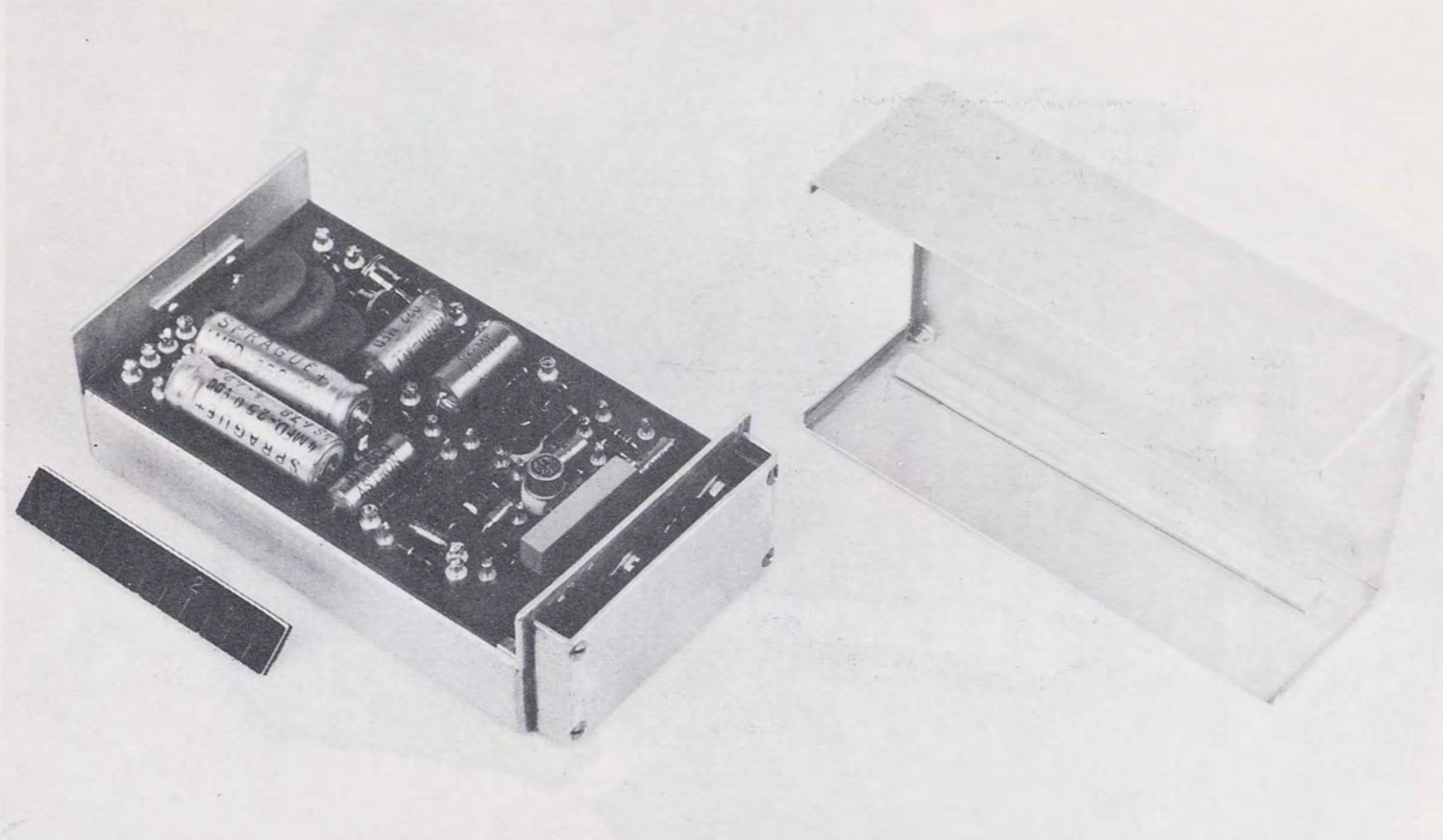


Fig. 9 AN/PPS-6, Model 2. Power Converter

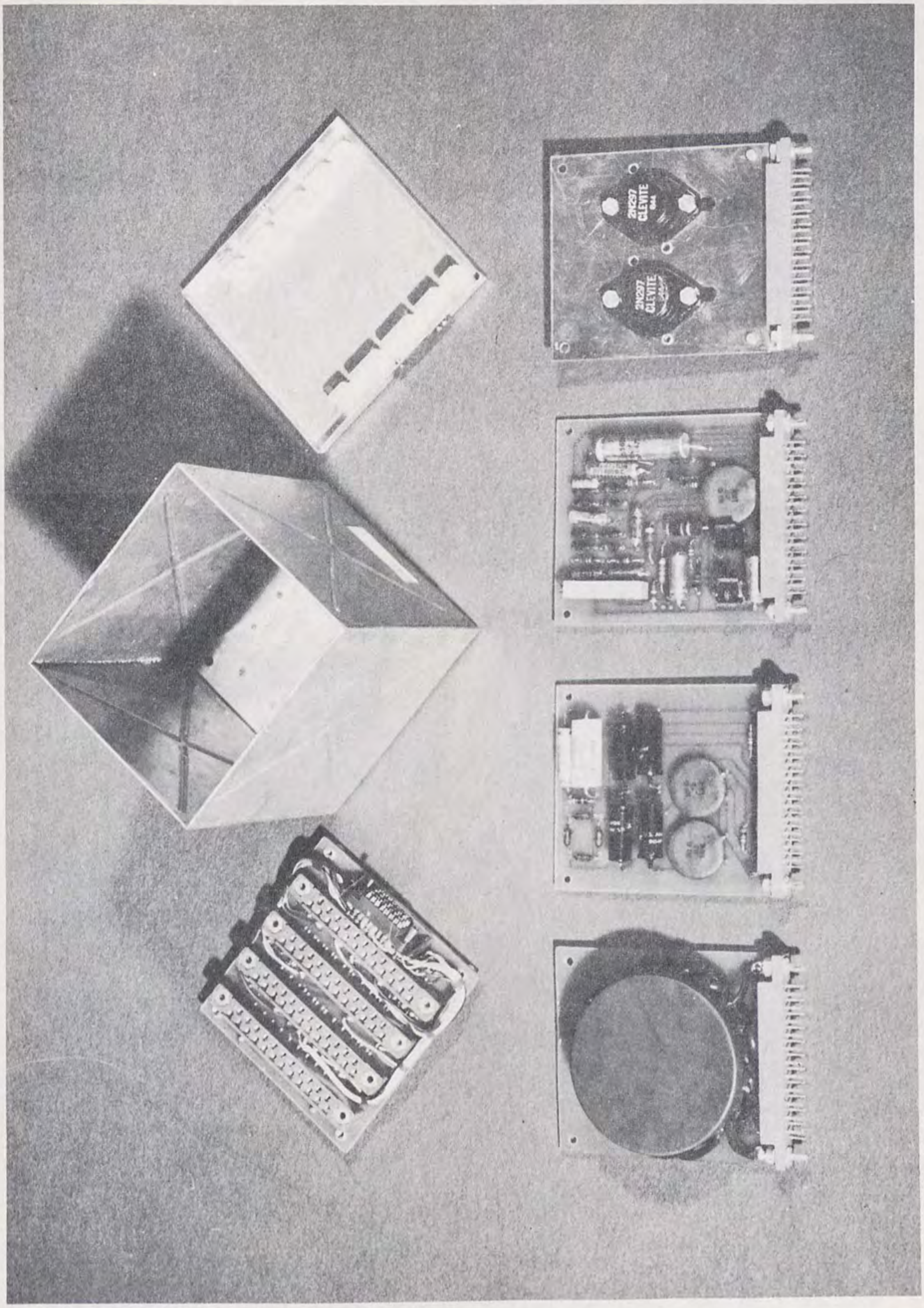


Fig. 10 AN/PPS-6, Model 1. Power Converter

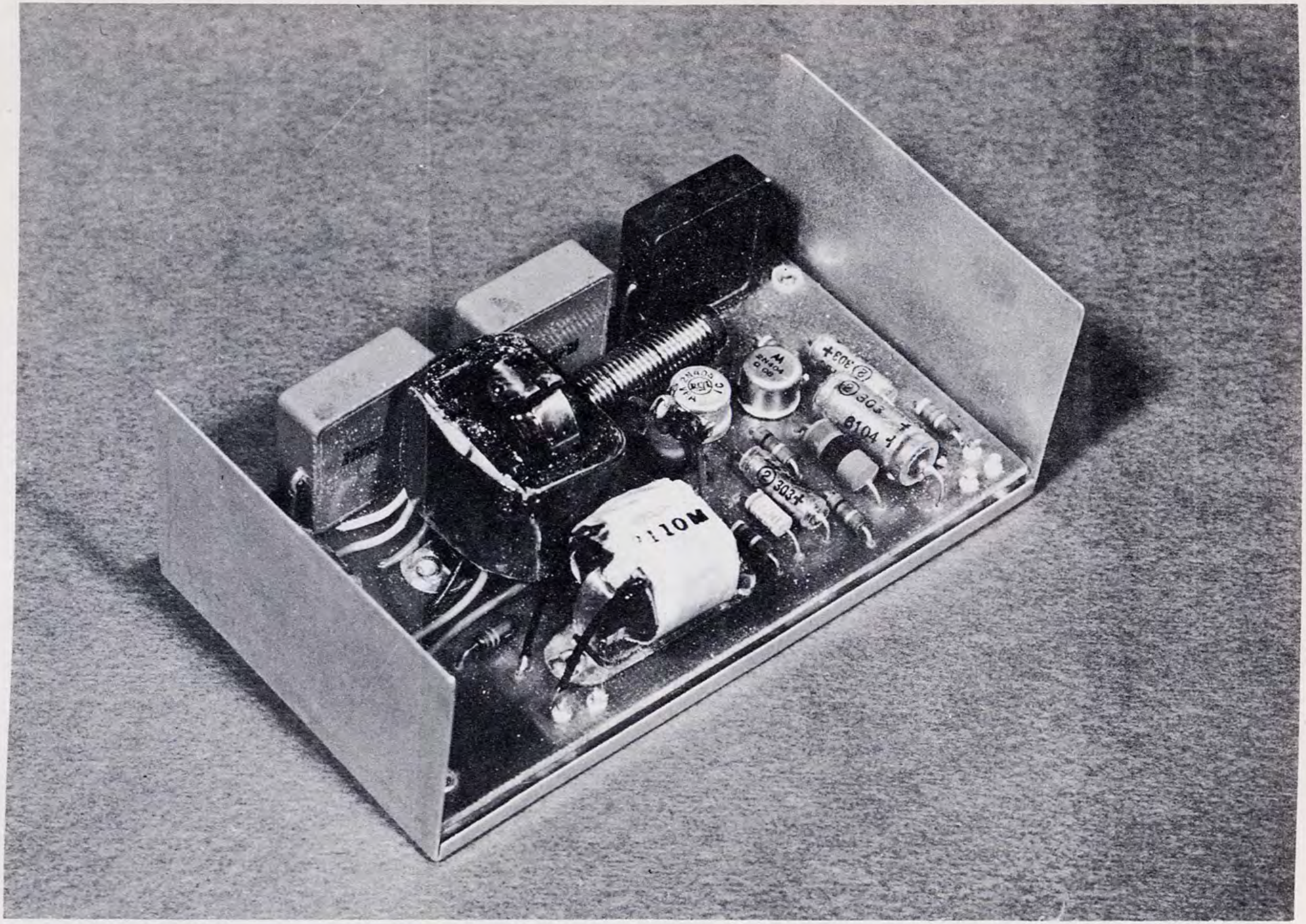


Fig. 11 AN/PPS-6, Modulator

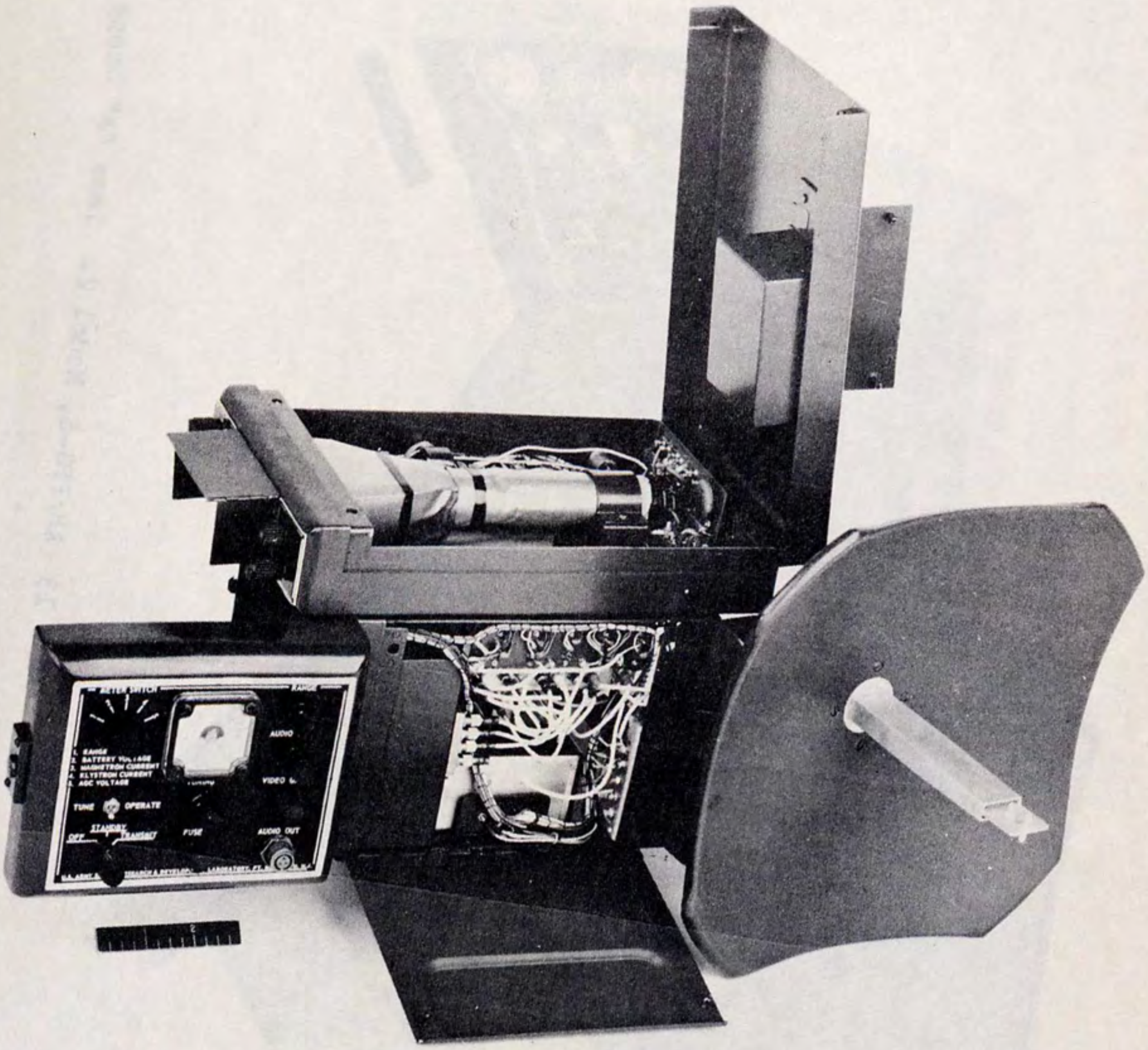


Fig. 12 AN/PPS-6, Model 2. Exploded View

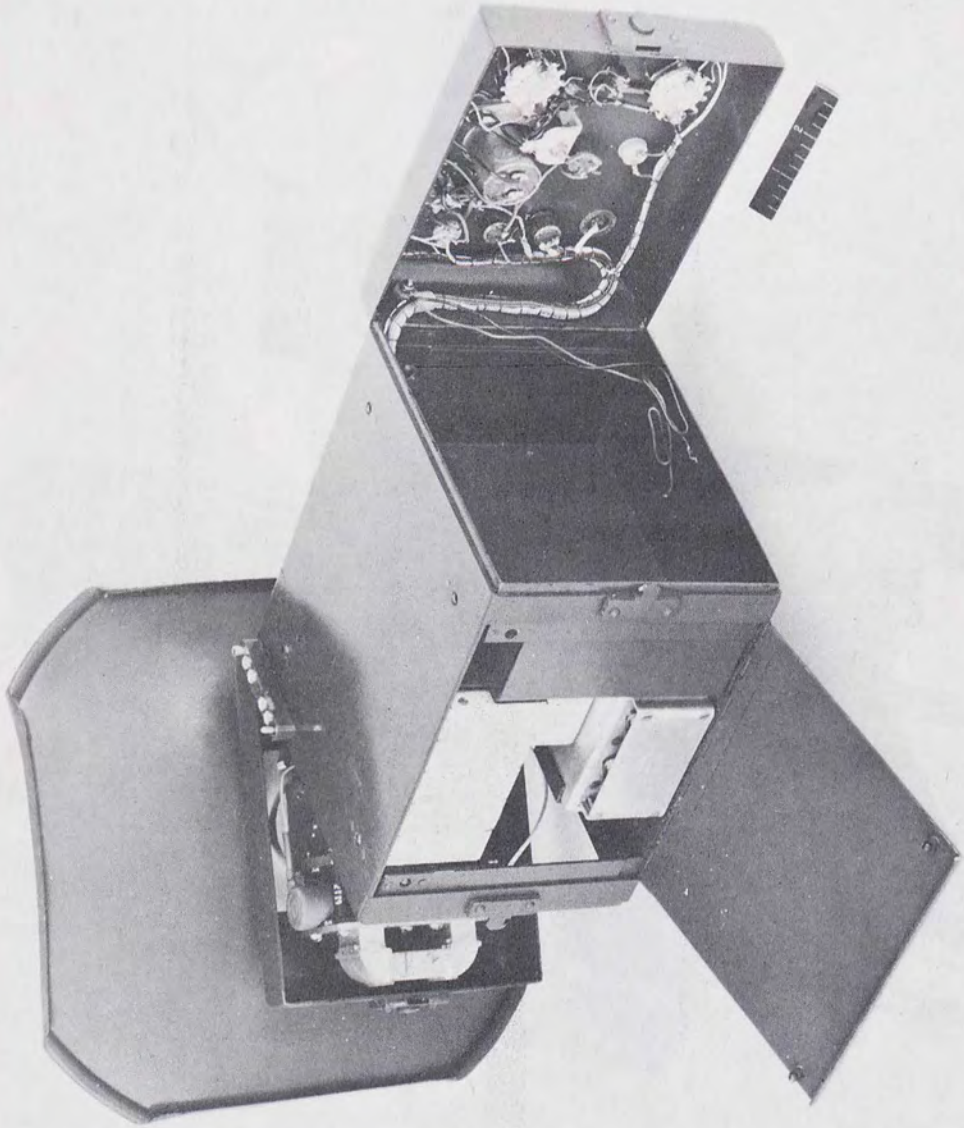


Fig. 13 AN/PPS-6, Model 2. Less "A" Scope

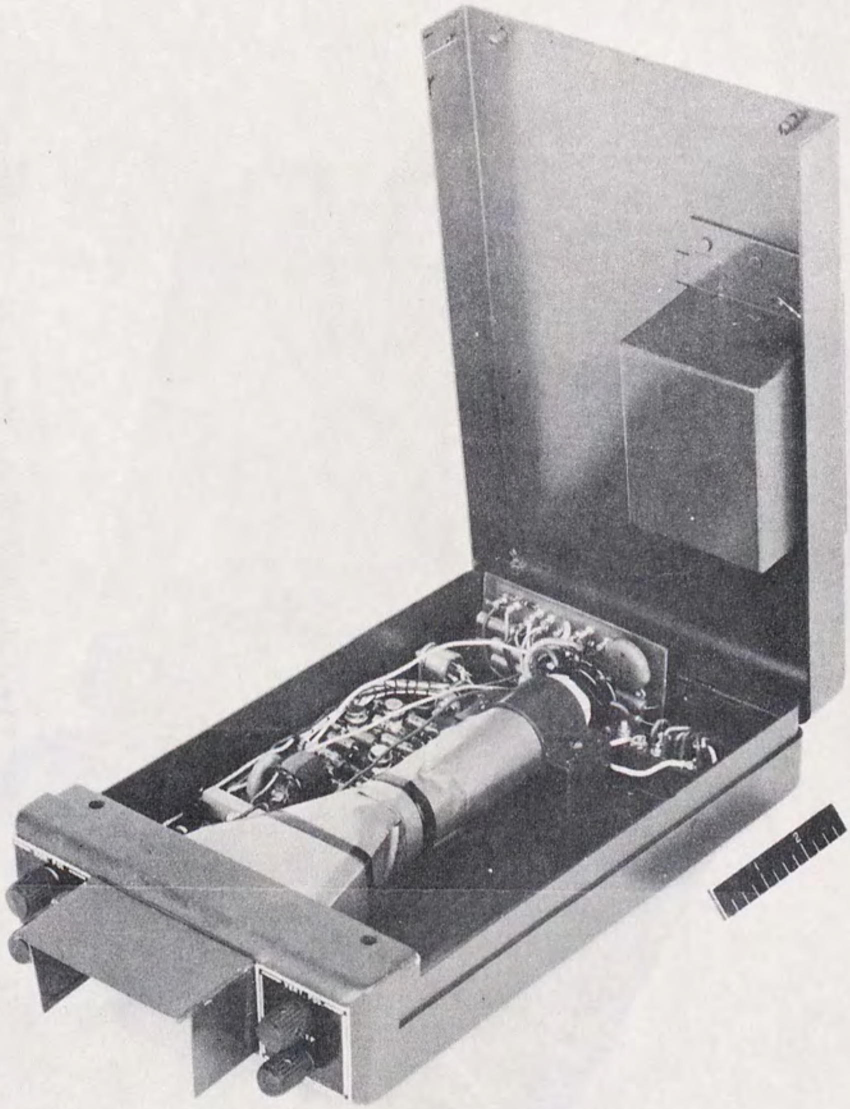


Fig. 14 "A" Scope, Model 2

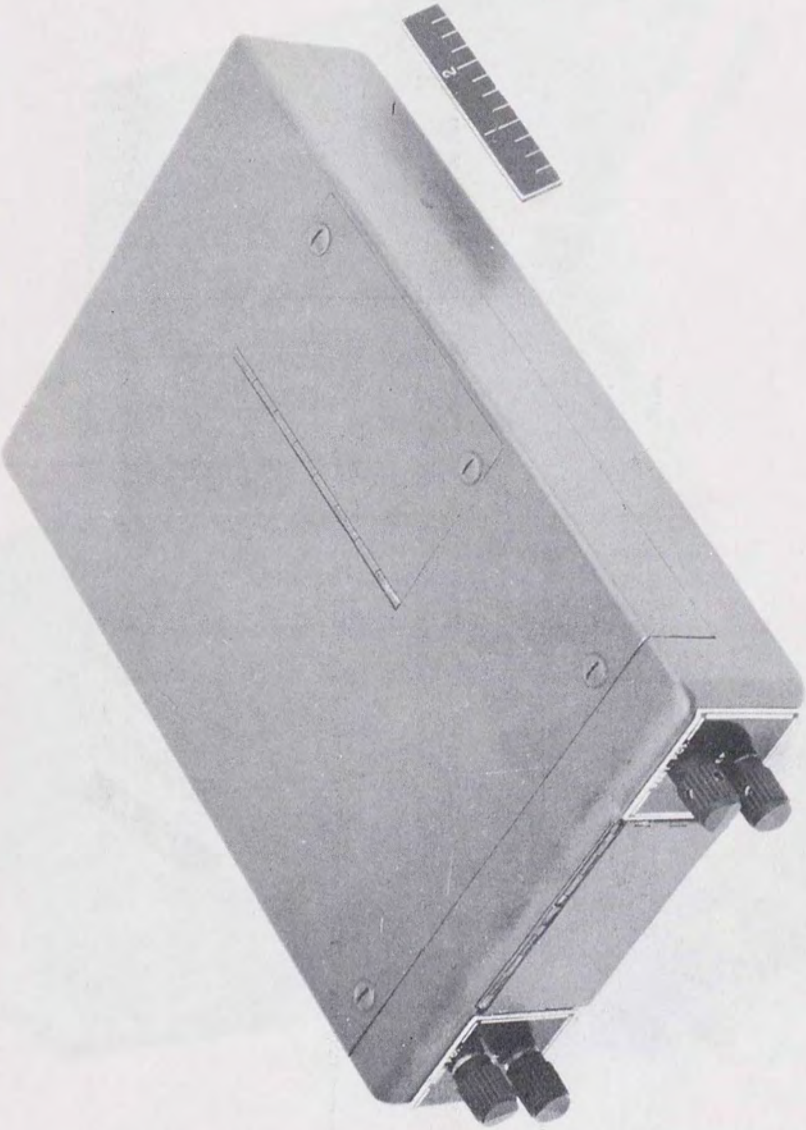
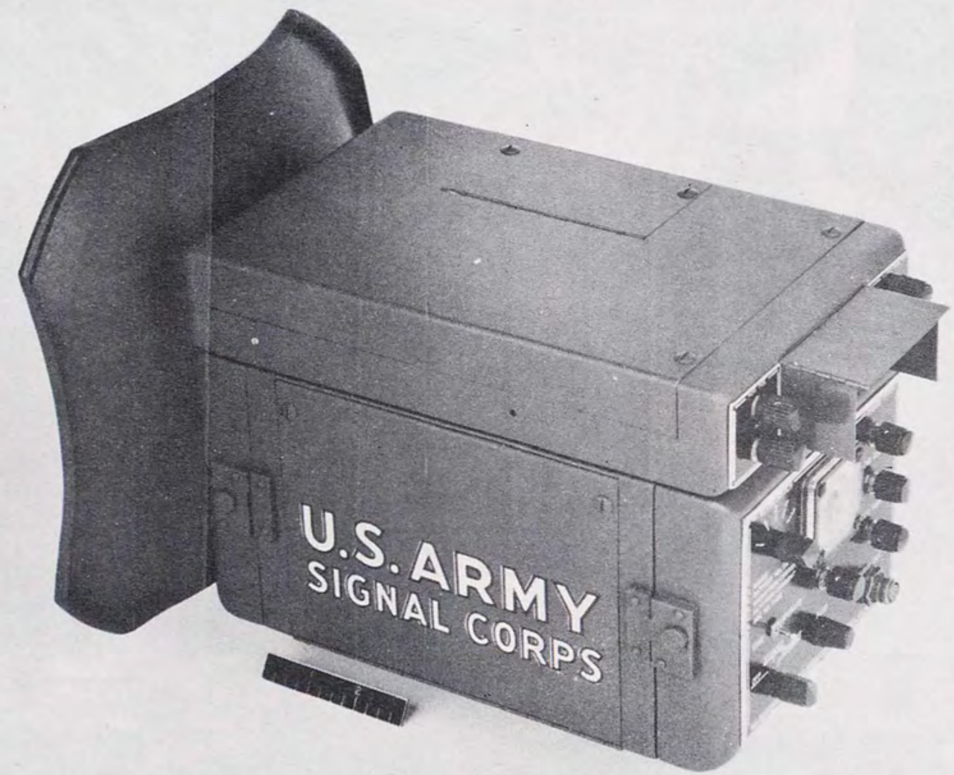


Fig. 15 AN/PPS-6, Model 2. "A" Scope



M-62-286

Fig. 16 AN/PPS-6, Model 2. Complete Package

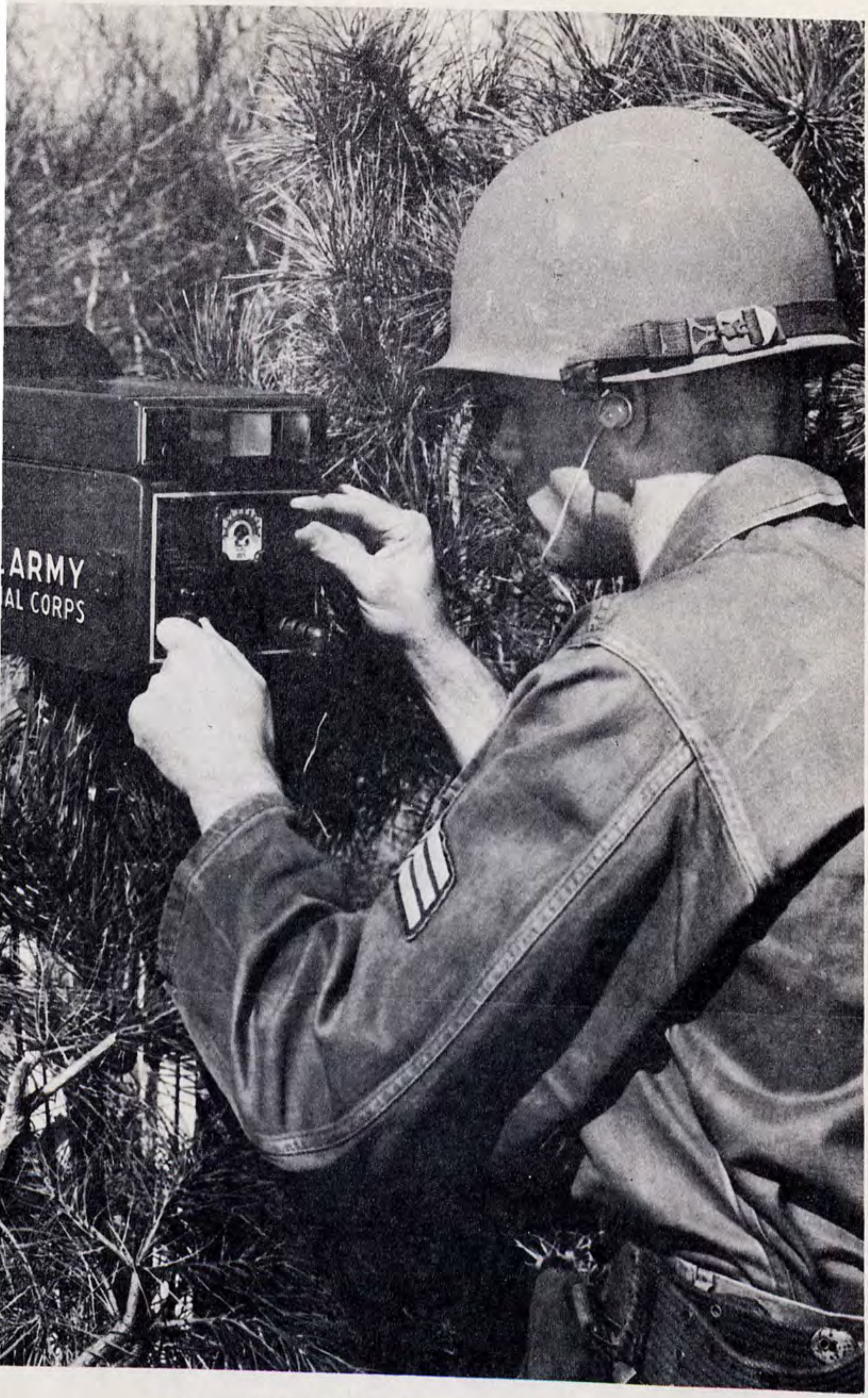


Fig. 17 AN/PPS-6, Model 2

APPENDIX I

MODULAR CIRCUIT SYSTEMS AREA
ELECTRONIC PARTS AND ASSEMBLIES BRANCH
ELECTRONIC PARTS AND MATERIALS DIVISION
ELECTRONIC COMPONENTS DEPARTMENT

SIGRA/SL-PEP
3D58-05-001-05

29 January 1962

TEST REPORT #1497

MEMORANDUM FOR: Chief, Electronic Parts and Assemblies Branch, Electronic Parts and Materials Division, Electronic Components Department, USASRDL

S U B J E C T : AN/PPS-6 Automatic Gain Control and Klystron Pulser Subassembly

1. INTRODUCTION:

The objective of this EP&M Div. effort is to provide a modularized, printed wiring version (MARK IV) of the AN/PPS-6 radar set. This model is to have electrical characteristics comparable to those of the experimental hand-wired model fabricated by the Radar Division. This effort includes adjustments, circuit corrections and changes in component values necessary to insure performance in compliance with technical requirements supplied by the Radar Division.

This report specifically covers effort on the Automatic Gain Control (AGC) and Klystron Pulser Subassembly.

2. DESCRIPTION:

The AN/PPS-6 AGC and Klystron Pulser Subassembly, as designed in the printed wiring version, uses one circuit board, 5 1/4" long by 1 5/8" wide. The AGC and the Klystron Pulser circuits, although physically mounted on this one board, are electrically independent circuits and were tested as individual circuit functions. The printed wiring board is contained in an aluminum case, 5 1/2" long by 1 7/8" wide by 3/4" thick. Total weight of this subassembly is 2.3 oz. Figure 1 shows the subassembly with the cover removed.

3. REQUIREMENTS:

a. Automatic Gain Control Unit. As outlined in the Radar Division specification for the AGC unit, this circuit was desired to generate a dc voltage varying from -8 volts to -1 volt as the input pulse amplitude is varied from 12 volts to 15 volts.

b. Klystron Pulser Unit. As outlined in the Radar Division specification for the klystron pulser unit, this circuit is required to provide an output pulse of -200 volts with a rise time of less than three microseconds, and a pulse width of not less than 19 nor greater than 25 microseconds. This output is to be developed across a 10,000 ohm resistive load.

4. PROCEDURE:

a. Automatic Gain Control Unit. As shown in Figure 2, the -12 volts required to operate the AGC unit was supplied by a battery. A twelve volt 0.5 microsecond pulse at a repetition rate of 2000 cycles per second, provided by a Rutherford Model B7B Pulse Generator, was fed into the range notch input. The AGC output was monitored on a Tektronix Model 545A Oscilloscope.

b. Klystron Pulser Unit. As shown in Figure 3, the -12 volt and -200 volt dc supply voltages required by the klystron pulser were supplied by the AN/PPS-6 power converter (see EP&A Div. Test Report #55-1). The 6 volt, one microsecond input pulse was provided by a Rutherford Model B7B Pulse Generator and the output was monitored on a Tektronix Model 545A Oscilloscope.

5. SUMMARY OF RESULTS:

a. Automatic Gain Control Unit. A pulse amplitude of +11 volts applied to the input of the AGC unit resulted in a dc output of -8 volts. Increasing the input pulse amplitude to 15 volts resulted in an output of -4 volts; an input of 17 volts was required to reduce the output to the desired -1 volt. These results were considered satisfactory by Mr. Charles Rush, the AN/PPS-6 project engineer of the Radar Division.

b. Klystron Pulser Unit. The output pulse exceeded the maximum specified pulse width of by about 5 microseconds. Increasing by 200 ohms the value of the 1000 ohm resistor in the base return of the driver transistor resulted in a satisfactory pulse width of 23 microseconds. Later models of this set use a variable resistor which can be set for different component parameters.

The final output pulse from the klystron pulser had an amplitude of -200 volts, a rise time (10% - 90%) of 1.8 microseconds, a flat top pulse width of 23 microseconds and a fall time (90% - 10%) of 15 microseconds.

With the approval of Mr. Rush, an additional change was made in this circuit to improve the shape of the gate pulse to the Controlled Rectifier. This consisted of adding a parallel RC network (390 ohms resistor and 0.005 microfared capacitor) in series with the 1N 277 diode connected across one winding of the pulse transformer.

6. CONCLUSIONS:

Performance of the subassembly containing both the AGC and the klystron pulser circuits meets the requirements set forth by the Radar Division specifications for this subassembly.

PREPARED BY: ____________________
JAMES VAN DOVER
Project Engineer

APPROVED BY: ____________________
R. A. GERHOLD, Chief
Modular Circuits Systems Area
Elec Pts & Assemblies Branch
Elec Pts & Matls Division

Copy furnished
Dir, EP&M Div
Dir, EC Dept
Radar Div
M&R FU #1

AUTOMATIC GAIN CONTROL

BLOCK DIAGRAM

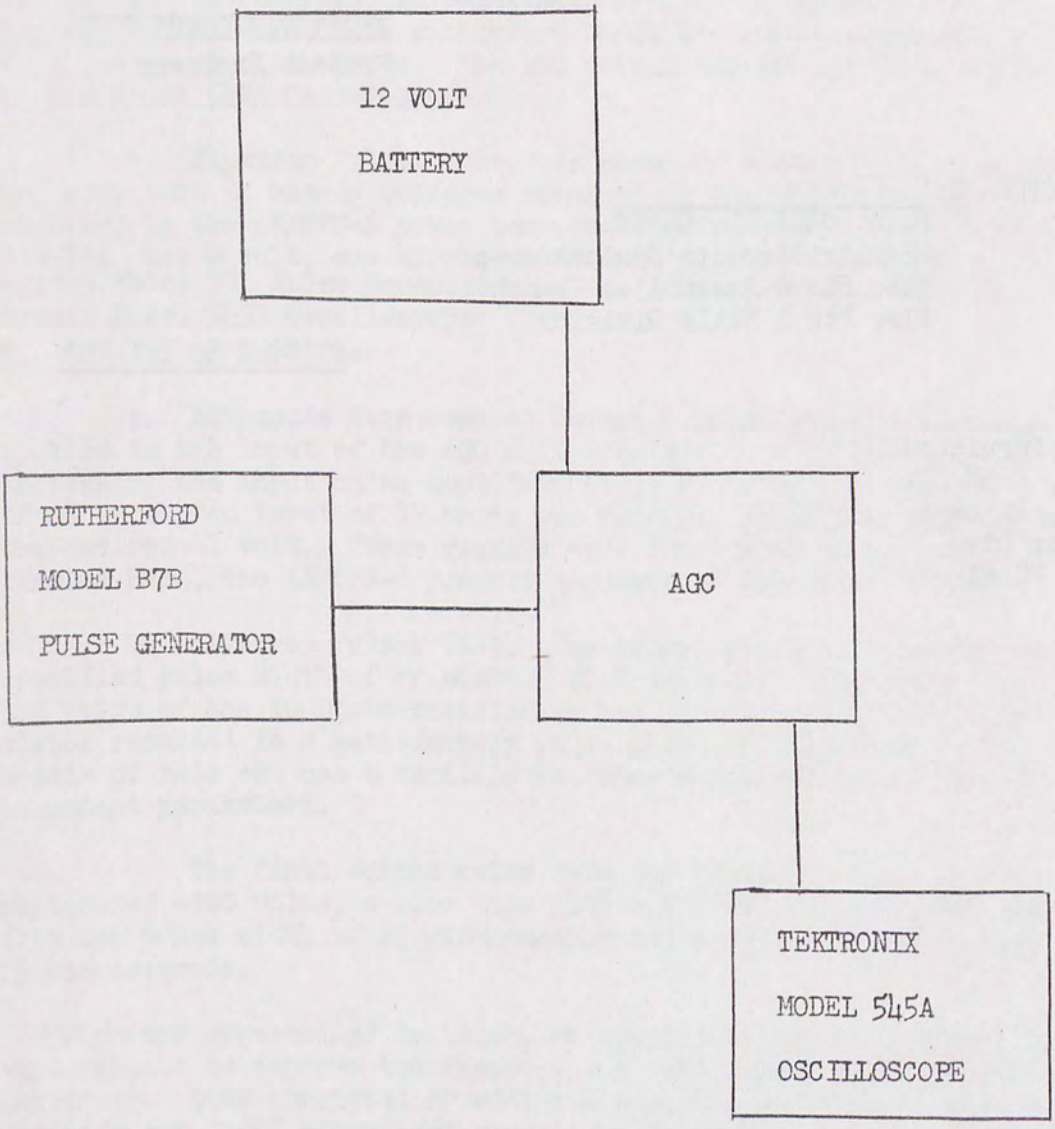


FIGURE 2

BLOCK DIAGRAM - KLYSTRON PULSER

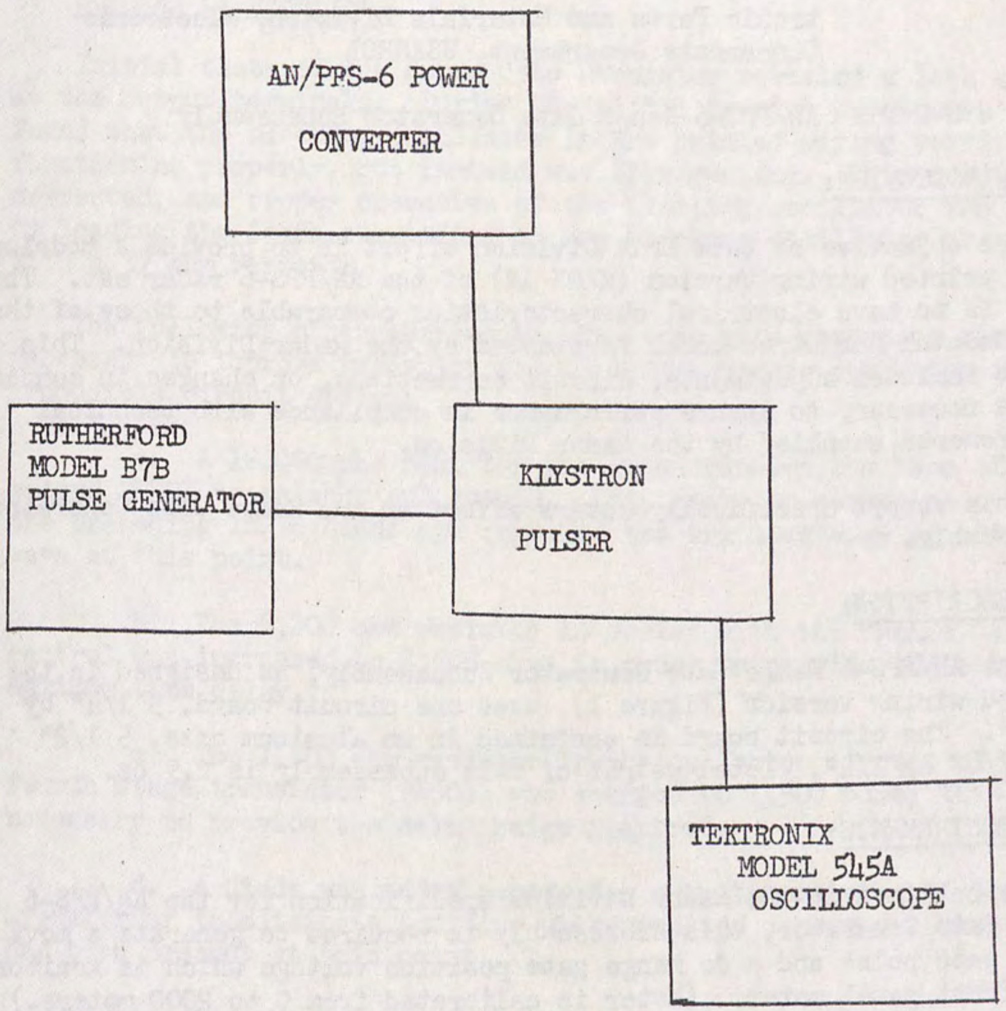


FIGURE 3

APPENDIX II

MODULAR CIRCUIT SYSTEMS AREA
ELECTRONIC PARTS AND ASSEMBLIES BRANCH
ELECTRONIC PARTS AND MATERIALS DIVISION
ELECTRONIC COMPONENTS DEPARTMENT

SIGRA/SL-PEP
3D58-05-001-05

2 February 1962

TEST REPORT #1498

MEMORANDUM FOR: Chief, Electronic Parts and Assemblies Branch, Electronic Parts and Materials Division, Electronic Components Department, USASRDL

S U B J E C T : AN/PPS-6 Range Gate Generator Subassembly

1. INTRODUCTION:

The objective of this EP&A Division effort is to provide a modularized, printed wiring version (MARK IV) of the AN/PPS-6 radar set. This model is to have electrical characteristics comparable to those of the experimental handwired model fabricated by the Radar Division. This effort includes adjustments, circuit corrections, or changes in component values necessary to insure performance in compliance with technical requirements supplied by the Radar Division.

This report specifically covers effort on the Range Gate Generator Subassembly.

2. DESCRIPTION:

The AN/PPS-6 Range Gate Generator Subassembly, as designed in the printed wiring version (Figure 1), uses one circuit board, 5 1/4" by 1 5/8". The circuit board is contained in an aluminum case, 5 1/2" by 1 7/8" by 3/4". Total weight of this subassembly is 2.9 oz.

3. REQUIREMENTS:

As outlined in the Radar Division specification for the AN/PPS-6 Range Gate Generator, this subassembly is required to generate a movable range gate pulse and a dc range gate position voltage which is monitored on a front panel meter. (Meter is calibrated from 0 to 2000 meters.)

The range gate output pulse is to have a 10 volts peak amplitude and be 0.5 microsecond wide. This pulse is to have a delay range (i.e. maximum delay minus minimum delay) of 13.3 microseconds, corresponding to a range of 2000 meters. Minimum delay is to be about 4 microseconds. Tolerances for these values were established by agreement between Mr. C. Rush, AN/PPS-6 Project Engineer in the Radar Division and EP&A Branch personnel.)

4. PROCEDURE:

As shown in Figure 2, the -8 and -12 volt dc voltages required for test of this unit were supplied by batteries. The -3 volt, one microsecond, 2 kilocycle pulse repetition rate trigger input pulse was provided by a Rutherford Model B7B Pulse Generator and the output pulse was monitored on a Tektronix Model 545A Oscilloscope.

5. SUMMARY OF RESULTS:

Initial tests of the Range Gate Generator revealed a lack of signal at the output terminals. During the signal tracing procedure, it was found that the blocking oscillator in the printed wiring version was not functioning properly, but instead was free running. This condition was corrected, and proper operation of the blocking oscillator was obtained, by loading the feedback winding of the blocking oscillator transformer with a 39 ohm resistor.

The following other changes to the range gate generator circuit were necessary to improve waveshape and to assure proper operation in a reproducible circuit design:

a. A 12,000 ohm resistor was added between the base of the second 2N501 transistor and ground. This resistor serves as a load for the preceding 1N276 diode and improves the trailing edge of the square wave at this point.

b. The 6,800 ohm resistor in series with the "Range Calibrate" control was increased to 8,200 ohms in order to provide the necessary maximum time delay.

c. The 1,800 ohm resistor in the collector circuit of the fourth stage transistor (2N502) was changed to 1,500 ohms; this was necessary to provide the delay range required.

d. A diode was added across the output terminals of the pulse transformer to eliminate positive overshoot and consequent ringing which had been present at this point.

Figures 3 a, b, and c are oscillograms of the output range gate pulse. As shown in Figure 3a, the output pulse is 0.6 microseconds wide and 11 volts in amplitude. Figures 3b and c show that the minimum delay is 4.0 microseconds and the maximum delay is 17.5 microseconds, resulting in a maximum range of 13.5 microseconds corresponding to the required 0 to 2000 meter operation.

6. CONCLUSIONS:

Performance of this subassembly meets the requirements set forth in the Radar Division specification for the Range Gate Generator Subassembly.

PREPARED BY:

JAMES K. VAN DOVER
Project Engineer

APPROVED BY:

R. A. GERHOLD, Chief
Modular Circuits Systems Area
Elec Pts & Assemblies Br
Elec Pts & Matls Division

BLOCK DIAGRAM

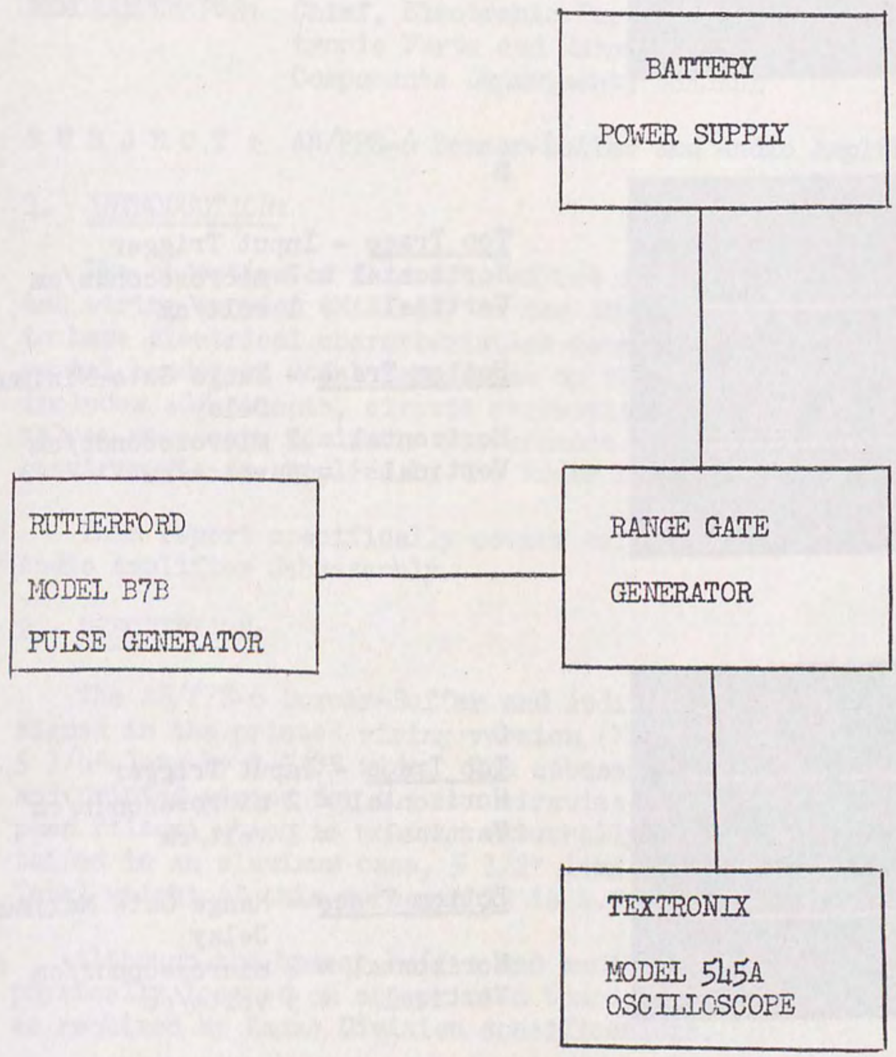
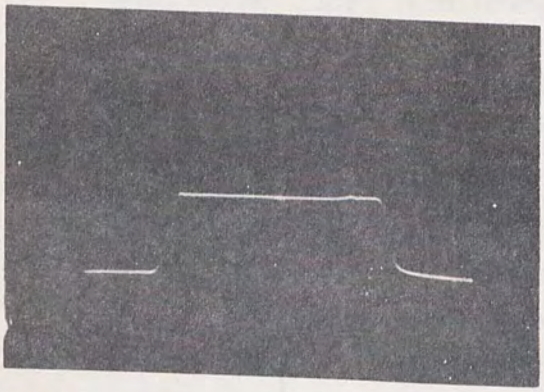
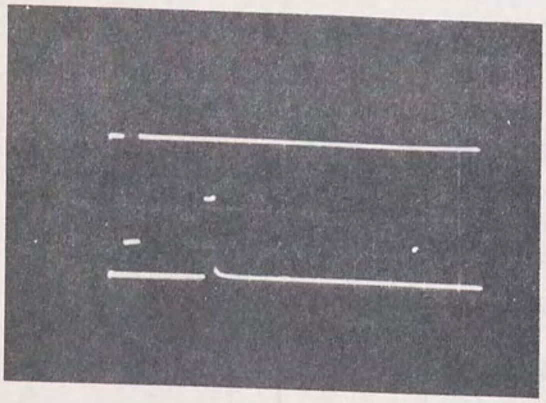


FIGURE 2



A

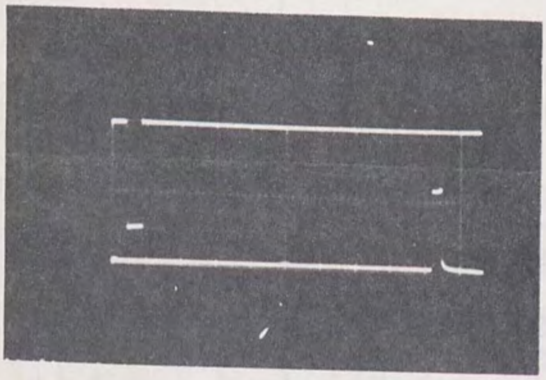
Range Gate Pulse
Horizontal = 0.1 microsecond/cm
Vertical = 5 volts/cm



B

Top Trace - Input Trigger
Horizontal = 2 microseconds/cm
Vertical = 1 volt/cm

Bottom Trace - Range Gate Minimum Delay
Horizontal = 2 microseconds/cm
Vertical = 5 volts/cm



C

Top Trace - Input Trigger
Horizontal = 2 microseconds/cm
Vertical = 1 volt/cm

Bottom Trace - Range Gate Maximum Delay
Horizontal = 2 microseconds/cm
Vertical = 5 volts/cm

FIGURE 3

APPENDIX III

MODULAR CIRCUIT SYSTEMS AREA
ELECTRONIC PARTS AND ASSEMBLIES BRANCH
ELECTRONIC PARTS AND MATERIALS DIVISION
ELECTRONIC COMPONENTS DEPARTMENT

SIGRA/SL-PEP
3D58-05-001-05

9 February 1962

TEST REPORT #1499

MEMORANDUM FOR: Chief, Electronic Parts and Assemblies Branch, Electronic Parts and Materials Division, Electronic Components Department, USASRDL

S U B J E C T : AN/PPS-6 Boxcar-Buffer and Audio Amplifier Subassembly

1. INTRODUCTION:

The objective of this EP&A effort is to provide a modularized, printed wiring version (MARK IV) of the AN/PPS-6 radar set. This model is to have electrical characteristics comparable to those of the experimental handwired model fabricated by the Radar Division. This effort includes adjustments, circuit corrections, or changes in component values necessary to insure performance in compliance with technical requirements as supplied by the Radar Division.

This report specifically covers effort on the Boxcar-Buffer and Audio Amplifier Subassembly.

2. DESCRIPTION:

The AN/PPS-6 Boxcar-Buffer and Audio Amplifier Subassembly as designed in the printed wiring version (Figure 1), uses one circuit board, 5 1/4" long by 1 5/8" wide. The subassembly contains all of the parts and printed wiring for the two circuits, with the exception of the low pass filter, which is mounted externally. The circuit board is contained in an aluminum case, 5 1/2" long by 1 7/8" wide by 3/4" high. Total weight of this subassembly is 4.2 oz.

Although the boxcar-buffer and audio amplifier circuits are both physically located on one printed board, they were tested separately as required by Radar Division specifications.

3. REQUIREMENTS:

a. Boxcar Buffer. As outlined in the Radar Division specification for the AN/PPS-6 Boxcar Buffer, this subassembly, when connected to the test circuit shown in Figure 2 and described under "Procedure" is required to provide a 1Kc output voltage when both input signals are present in time coincidence, and no output when inputs are not in time coincidence.

b. Audio Amplifier. As outlined in the Radar Division specification for the AN/PPS-6 audio amplifier, this subassembly (including the input low pass filter) accepts an audio signal of 1.0 millivolt in a frequency range of 50 cps to 1000 cps and provides an output of 0.7 volt. This amplifier is frequency sensitive. The pass band should peak at 200 cps, with the low frequency cutoff (3 db down) point occurring at approximately 65 cps and the high frequency cutoff (3 db down) at approximately 650 cps. At about 1000 cps, the output should start to fall very sharply.

4. PROCEDURE:

a. Boxcar-Buffer. As shown in Figure 2, a test setup using several of the previously tested AN/PPS-6 subassemblies is required in order to check the operation of the boxcar-buffer circuits. DC power for the boxcar-buffer, as well as the other AN/PPS-6 subassemblies required for this test, was supplied by the AN/PPS-6 Power Converter. The range notch signal was supplied by the range gate generator and a simulated video signal was provided by a Rutherford Model B7B Pulse Generator. This pulse generator was triggered by a binary divider which had to be constructed especially for this purpose. The divider was driven by a signal from the AN/PPS-6 Trigger Generator. No troubles were encountered in testing this subassembly.

b. Audio Amplifier. As shown in Figure 3, the -12 volt dc for the Audio Amplifier was supplied by a battery. The input, provided by Hewlett Packard Model 650A test Oscillator, was fed to the amplified input through a 10,000 ohm resistor and the AN/PPS-6 low pass filter mentioned previously. The input and output voltages were monitored and measured on a Tektronix Model 545A Oscilloscope with a dual input preamplifier.

5. SUMMARY OF RESULTS:

a. Boxcar-Buffer. With all dc potentials applied and the signal from range gate generator adjusted to be in time coincidence with the simulated video signal, a 1000 cps output was obtained. Moving the range notch to a point where it was no longer in time coincidence with the video signal resulted in the desired loss of the output signal.

b. Audio Amplifier. As required by the Radar Division specification, a frequency response test for the Audio Amplifier was run from 50 cps to 2000 cps. Maximum gain occurred at 200 cps, as desired, and the response was 3 db down at 70 cps and at 600 cps. Figure 4 shows a plot of Vmin/Vi versus frequency, where Vi is the input voltage required to produce a 0.7 volt output voltage at each frequency and Vmin is the minimum Vi, as observed at the 200 cps maximum gain point.

6. CONCLUSIONS:

Performance of both circuits in this subassembly meet the requirements as set forth in the Radar Division specifications for the boxcar-buffer and Audio Amplifier circuits.

PREPARED BY: ______________________
JAMES VAN DOVER
Project Engineer

APPROVED BY: ______________________
R. A. GERHOLD, Chief
Modular Circuits Systems Area
Elec Pts & Assemblies Branch
Elec Pts & Matls Div

Copy furnished:
Dir, EP&M Div
Dir, EC Dept
Radar Div
M&R FU #1

BLOCK DIAGRAM

TEST SETUP FOR BOXCAR BUFFER

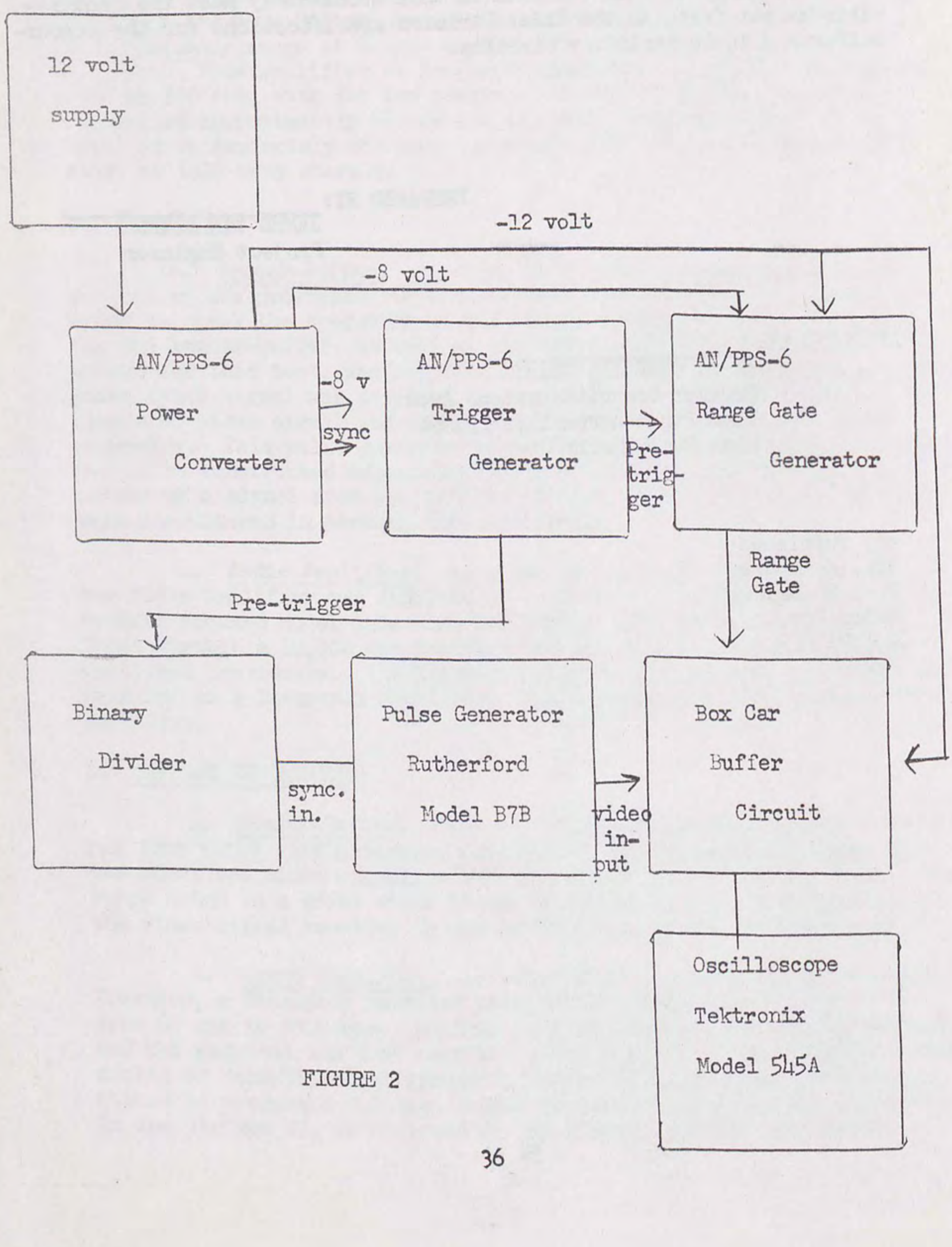


FIGURE 2

BLOCK DIAGRAM
TEST SETUP AUDIO AMPLIFIER

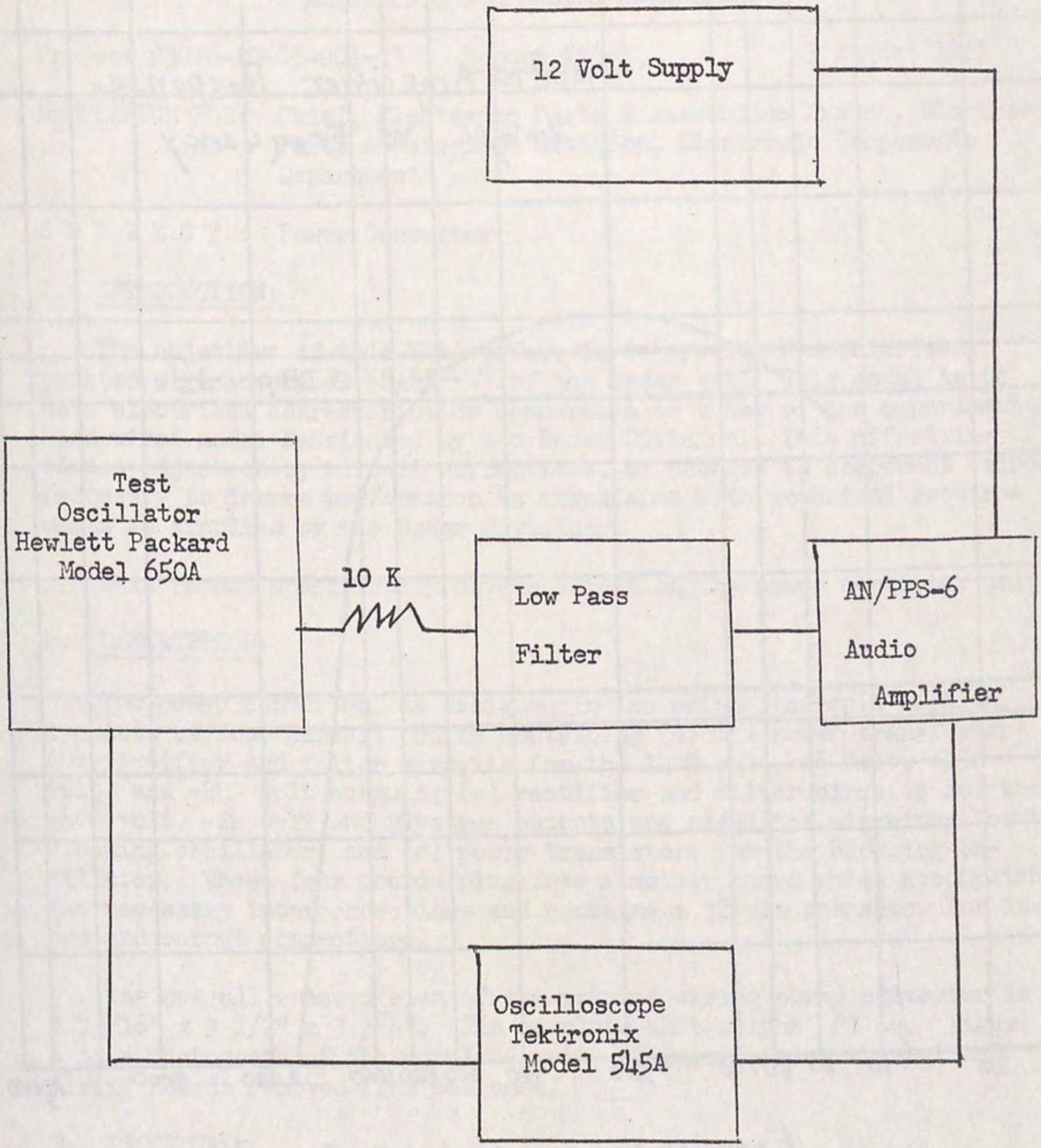


FIGURE 3

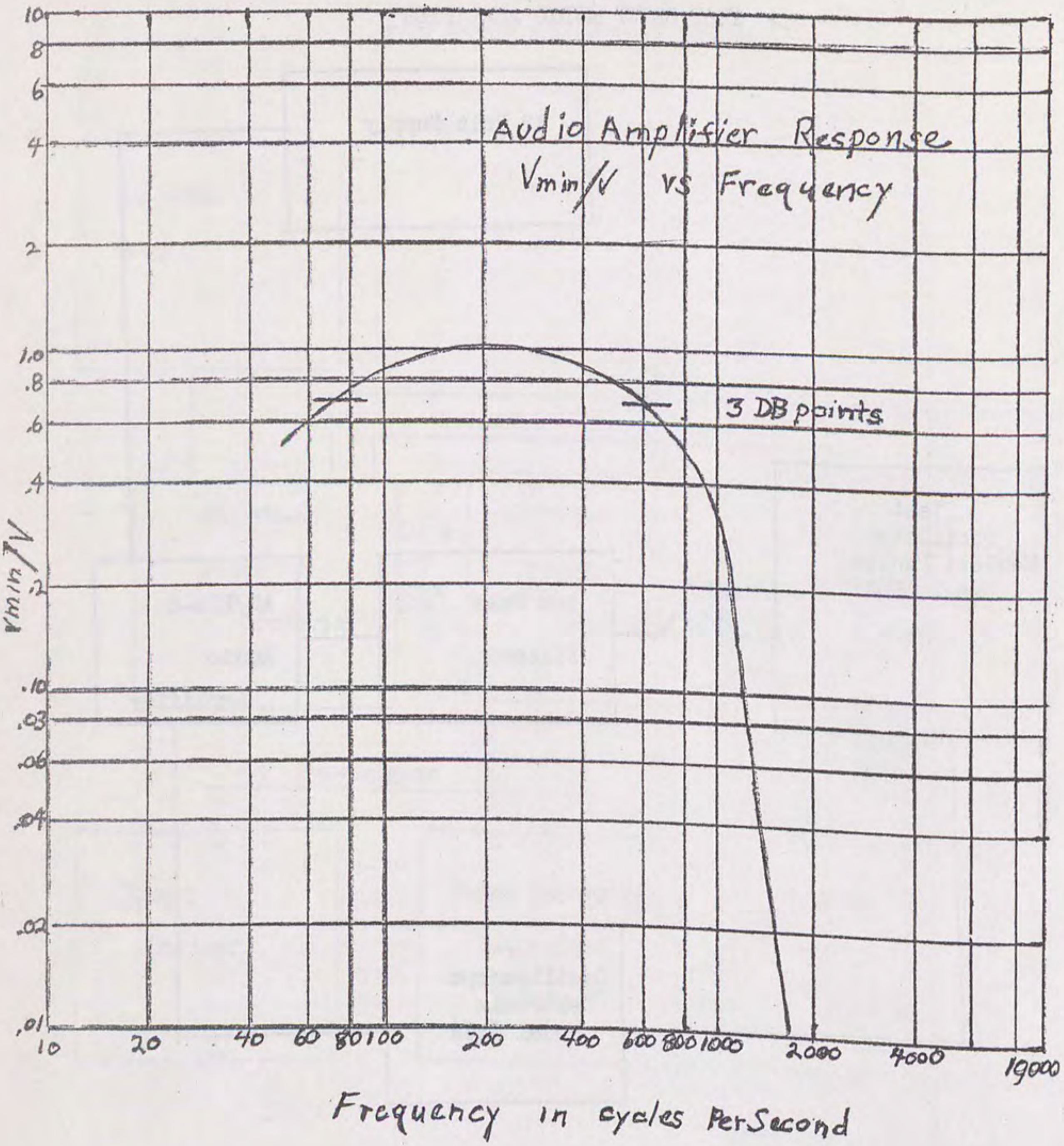

Audio Amplifier Response
Vmin/V vs Frequency
3 DB points
Vmin/V
10
8
6
4
2
1.0
.8
.6
.4
.2
.10
.08
.06
.04
.02
.01
10
20
40
60
80
100
200
400
600
800
1000
2000
4000
10000
Frequency in cycles Per Second

Figure 4

APPENDIX IV

MODULAR CIRCUITS SYSTEMS AREA
ELECTRONIC PARTS & ASSEMBLIES BRANCH
ELECTRONIC PARTS & MATERIALS DIVISION
ELECTRONIC COMPONENTS DEPARTMENT

Project #3G26-20-06-001-03 Report #55-1 3 August 1961

MEMORANDUM FOR: Chief, Electronic Parts & Assemblies Branch, Electronic Parts & Materials Division, Electronic Components Department

S U B J E C T : Power Converter

1. INTRODUCTION:

The objective of this EP&A effort is to provide a modularized, printed wiring version (MARK IV) of the radar set. This model is to have electrical characteristics comparable to those of the experimental hand-wired model fabricated by the Radar Division. This effort includes adjustments, circuit corrections, or changes in component values necessary to insure performance in compliance with technical requirements as supplied by the Radar Division.

This report specifically covers effort on the power converter unit.

2. DESCRIPTION:

The power converter, as designed in the printed circuit version, consists of four circuit boards containing (a) the power transformer; (b) rectifier and filter circuits for the 1400 volt, -8 volt, +150 volt, and -200 volt outputs; (c) rectifier and filter circuits for the -400 volt, -24 volt and klystron outputs and regulator circuitry for the blocking oscillator; and (d) power transistors for the blocking oscillator. These four boards plug into a mother board which accomplishes the necessary interconnections and contains a 32 pin connector for input and output connections.

The overall encased size of the printed wiring power converter is 4 13/16" x 3 1/2" x 3 3/4". The complete unit weighs 23 oz. Figure 4 is a photograph of the complete unit. Figure 5 shows the printed wiring boards removed from the case.

3. PROCEDURE:

A block diagram of the test setup is shown in fig 1. A load panel, containing dummy resistances to draw the proper load currents from all outputs of the converter, was connected to the output plug as indicated in the figure. The input voltage to the converter was gradually increased to 12 volts. The converter's voltage regulator was then adjusted to provide the proper output voltages and operating frequency.

The exact values of all output voltages were measured over a range of input voltages from 11.4 volts to 15 volts. Initial tests indicated that the readings for the +150 volt and -8 volt outputs were low. It was determined that the -8 volt circuit required a different type of zener regulator and that the transformer winding supplying the +150 volts needed 30 additional turns. These changes were made with the approval of the Radar Division.

4. SUMMARY OF RESULTS:

Results of the voltage measurement on all outputs are shown in Figures 2 and 3. These results are subsequent to replacement of the zener diode in the -8 volt circuit, but prior to the incorporation of a transformer with higher output for the +150 volt circuit.

5. REQUIREMENTS:

Nominal voltages and regulation were to be as shown in the Radar Division Power Supply specification, with tolerances as verbally agreed upon with the Radar Division.

6. CONCLUSIONS:

Performance of this subassembly meets the requirements as set forth in the Radar Division Power Supply specification.

JAMES K. VAN DOVER
Modular Circuit Systems Area

Approved by:

R. A. GERHOLD, Chief
Modular Circuits Systems Area
Electronic Parts & Assemblies Branch
Electronic Parts & Materials Division
Electronic Components Department

TEST PROCEDURE

BLOCK DIAGRAM

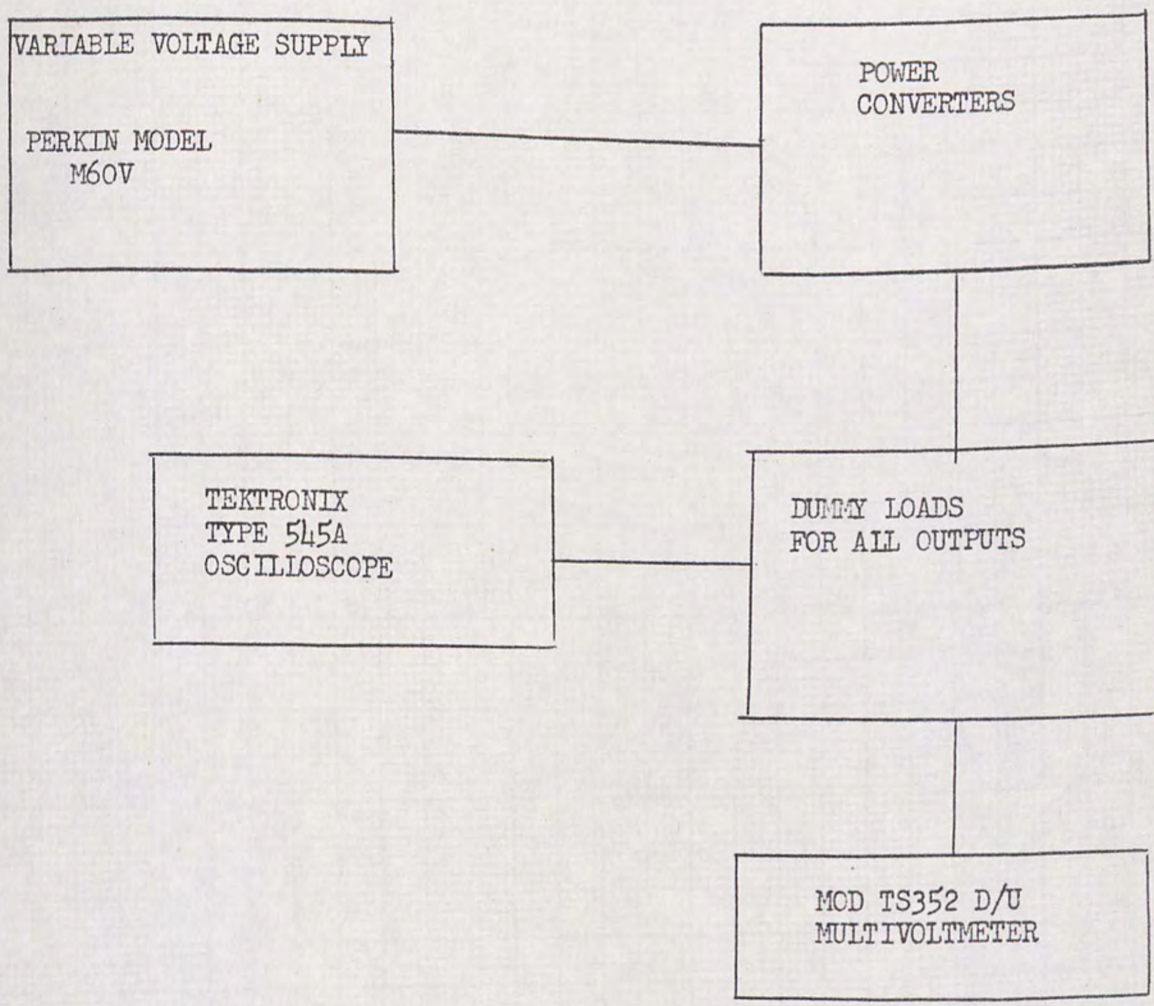


FIGURE 1

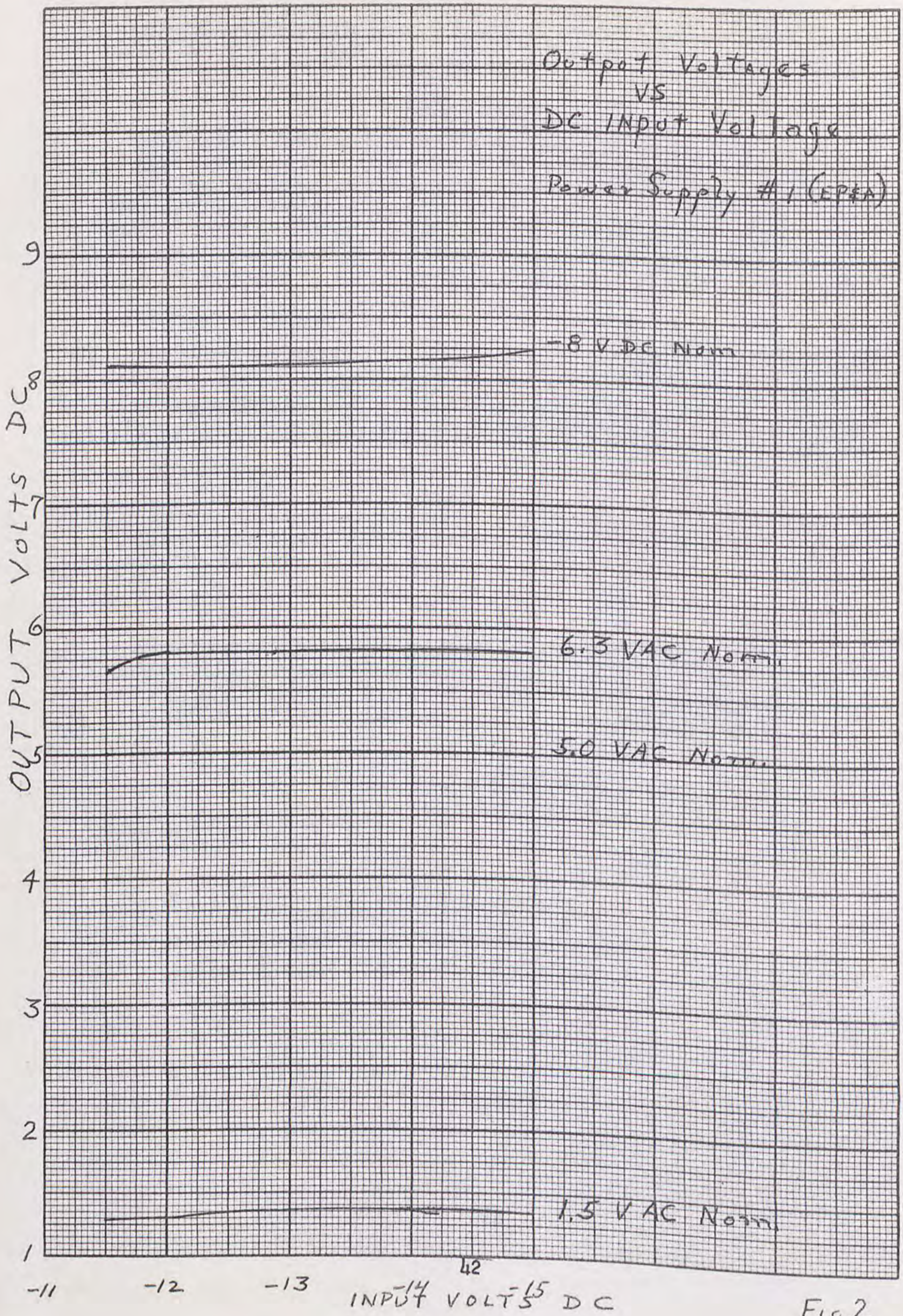

Output Voltages
VS
DC INPUT Voltage
Power Supply #1 (EPSA)
-8 V DC Nom
6.3 VAC Nom.
5.0 VAC Nom.
1.5 V AC Nom.
OUTPUT VOLTS DC
9
8
7
6
5
4
3
2
1
-11
-12
-13
-14
-15
INPUT VOLTS DC

Fig 2

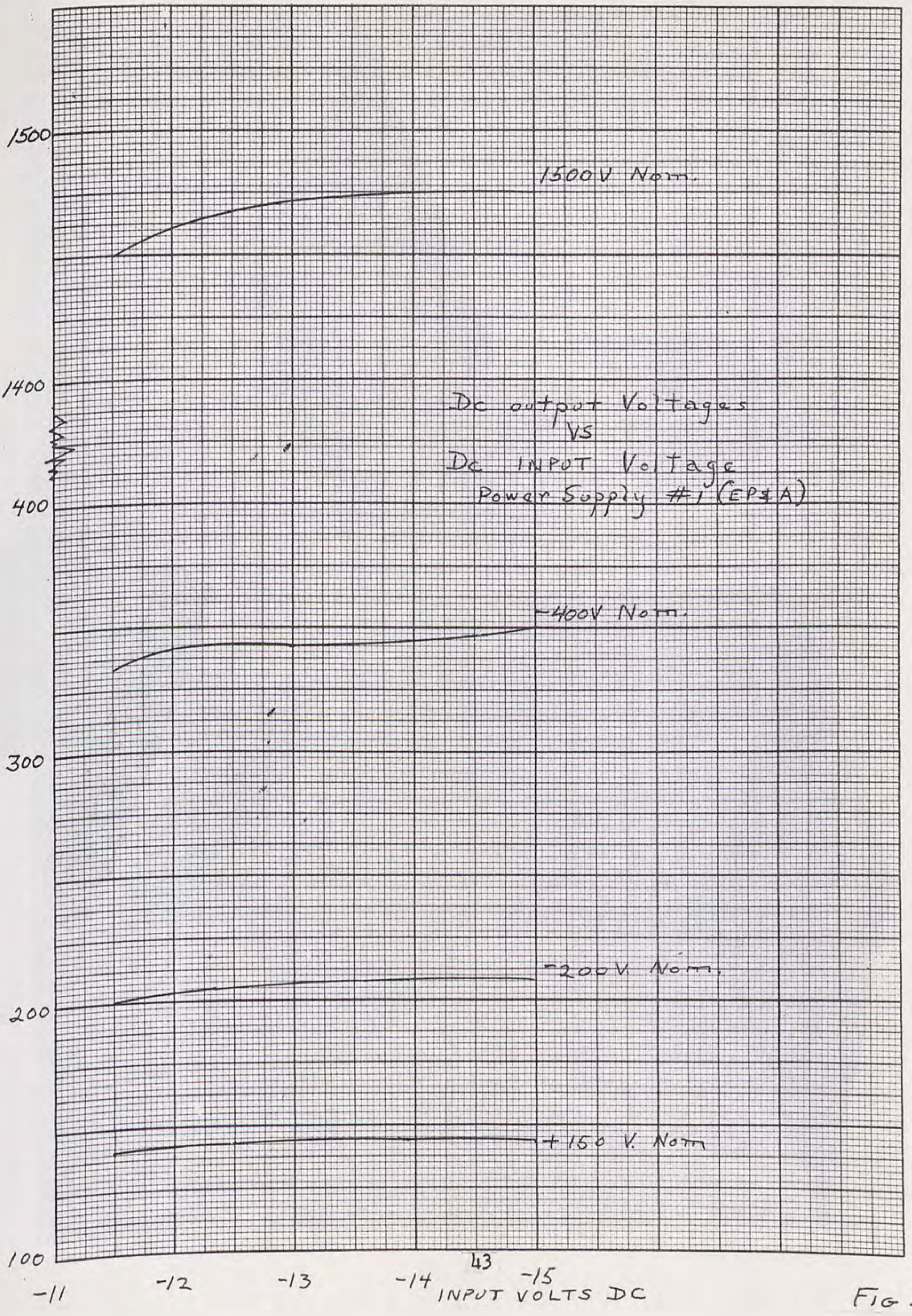

Dc output Voltages
vs
Dc INPUT Voltage
Power Supply #1 (EPS A)
1500V Nom.
-400V Nom.
-200V Nom.
+150 V. Nom
1500
1400
400
300
200
100
-11
-12
-13
-14
-15
INPUT VOLTS DC

Fig 3

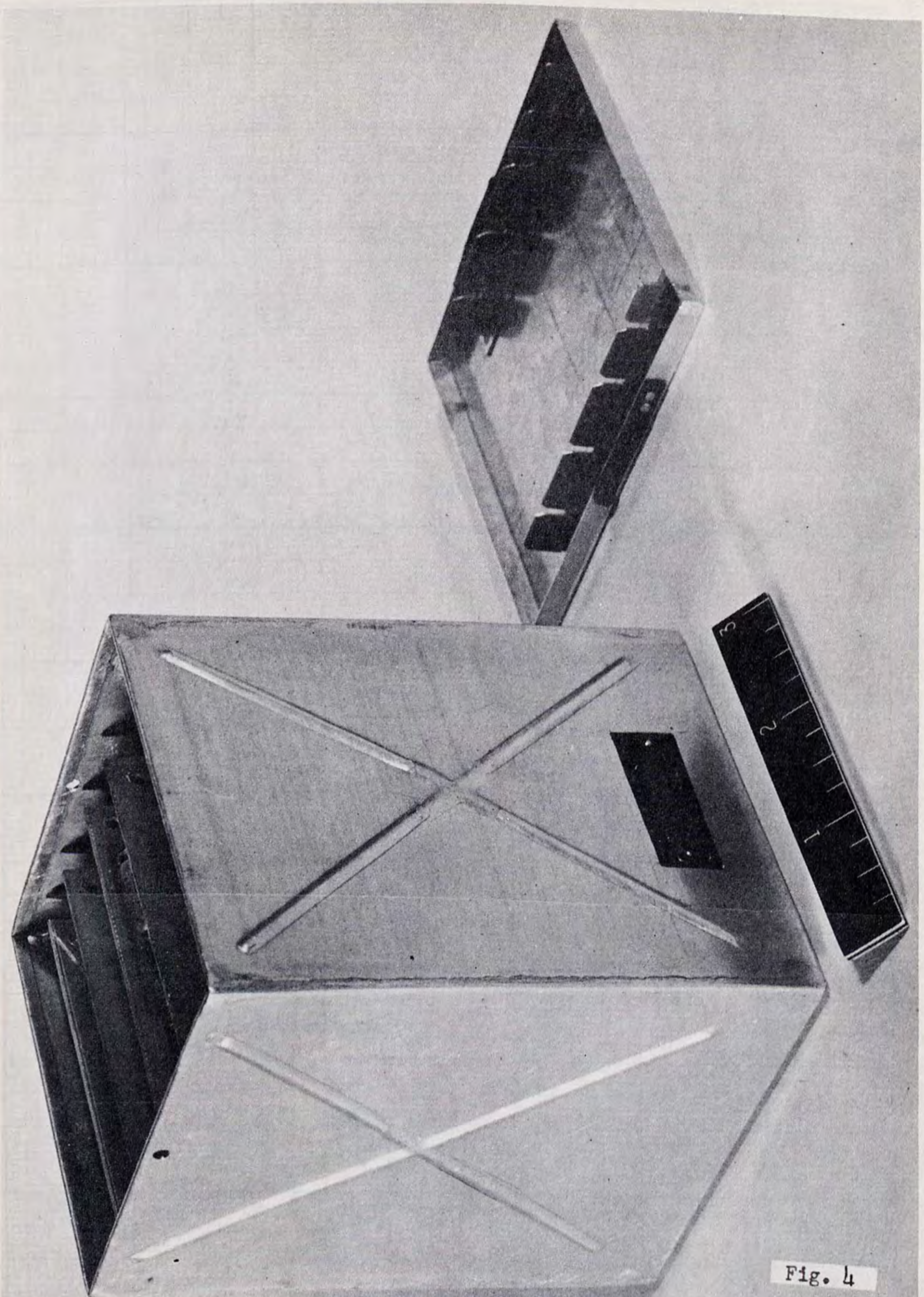


Fig. 4

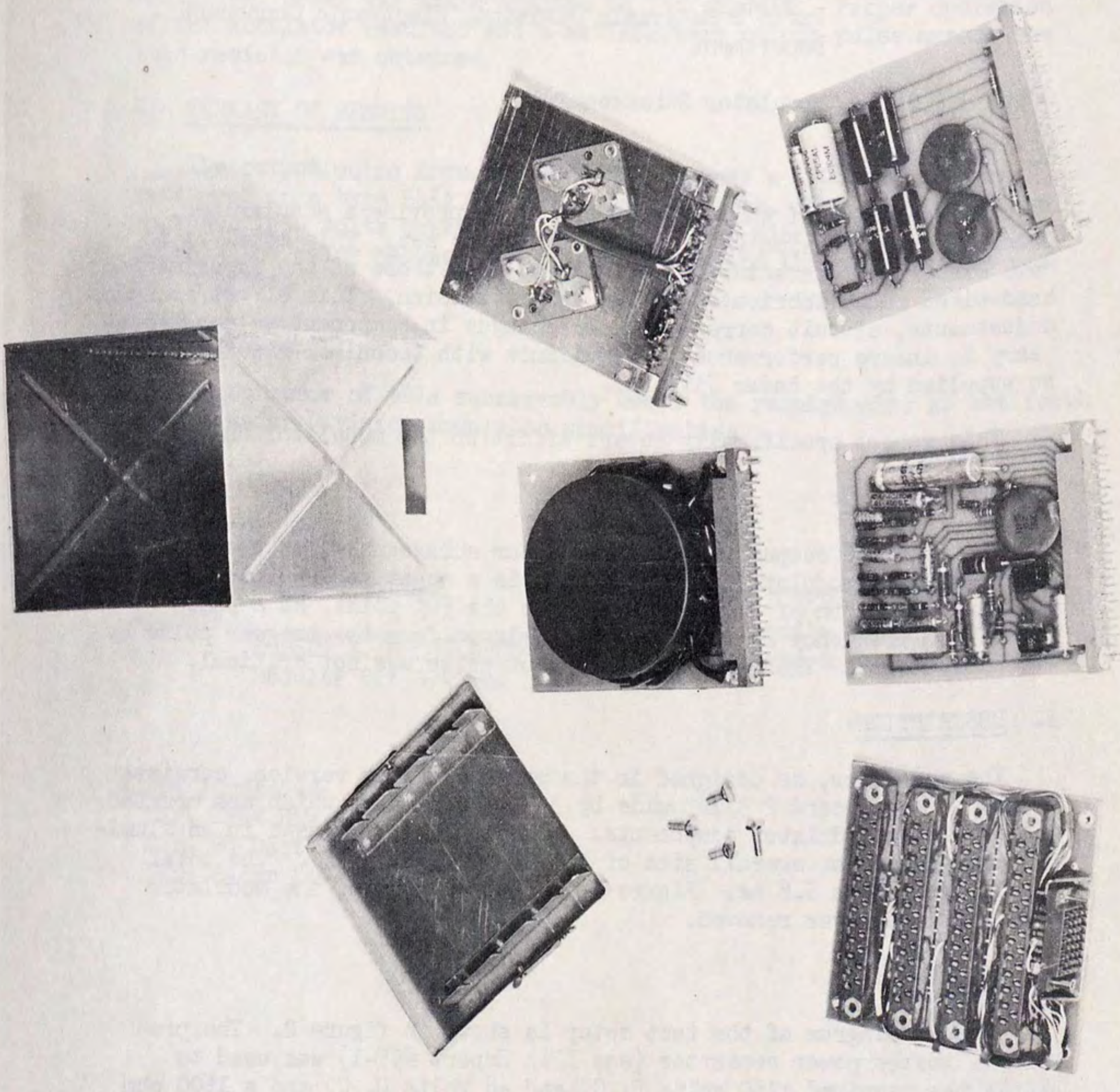


Fig. 5

APPENDIX V

MODULAR CIRCUITS SYSTEMS AREA
ELECTRONIC PARTS & ASSEMBLIES BRANCH
ELECTRONIC PARTS & MATERIALS DIVISION
ELECTRONIC COMPONENTS DEPT

Project #3G26-20-06-001-03 Report #55-3 24 August 1961

MEMORANDUM FOR: Chief, Electronic Parts & Assemblies Branch, Electronic Parts & Materials Division, Electronic Components Department

S U B J E C T : Modulator Subassembly

1. INTRODUCTION:

The objective of this EP&A effort is to provide a modularized, printed wiring version (MARK IV) of the radar set. This model is to have electrical characteristics comparable to those of the experimental hand-wired model fabricated by the Radar Division. This effort includes adjustments, circuit corrections, or changes in component values necessary to insure performance in compliance with technical requirements as supplied by the Radar Division.

This report specifically covers effort on the modulator unit.

2. REQUIREMENTS:

The required output from the modulator subassembly, as shown in the Radar Division modulator specification, is a negative 1450 peak volt pulse with a width of 0.4 microsecond at the 50% point, at a pulse repetition frequency of 2000 CPS, and delayed from the trigger pulse by 0.5 microsecond. The shape of the output pulse was not critical.

3. DESCRIPTION:

The modulator, as designed in the printed wiring version, consists of one printed board 2 3/16" wide by 3 7/8" long upon which are mounted all of the 22 modulator components. This board is inclosed in an aluminum case having an overall size of 1 1/2" x 2 5/16" x 4". The total encased weight is 5.6 oz. Figure 1 is a photograph of the modulator unit with the cover removed.

4. PROCEDURE:

A block diagram of the test setup is shown in figure 2. The previously tested power converter (see EP&A Report #55-1) was used to supply the required +150 volts D. C. and -8 volts D. C. and a 1500 ohm load resistor was connected from output to ground. A negative going, 5 volt, one microsecond pulse, with a pulse repetition frequency of 2000 CPS supplied by a Rutherford model B7B pulse generator was connected to the modulator input.

Initial application of the input signal resulted in an increase in the +150 volt current to over 100 ma. (This current is normally 15 ma) Power was removed and the circuit analyzed for possible reasons for this excessive current. The cause of this malfunction was found to be a defective type C11C controlled rectifier. After replacing the defective rectifier, power was again applied to the circuit. Proper operation of the modulator resulted and a satisfactory output pulse across the load resistor was obtained.

5. SUMMARY OF RESULTS:

The output pulse from the modulator across a 1500 ohm load was monitored on a type 545A Tektronix oscilloscope. The negative pulse measured 1450 volts peak, with a width of 0.4 microsecond at the 50% point. The delay between the trigger pulse and the output pulse was 0.5 microsecond.

6. CONCLUSIONS:

Performance of this subassembly meets the requirements as set forth in the Radar Division modulator specification.

JAMES K. VAN DOVER
Modulator Circuits Systems Area
Electronic Parts & Assemblies Branch

Approved:
ROBERT A. GERHOLD, Chief
Modular Ckt Systems Area

Copy furnished:
Dir, EP&M Div
Dir, EC Dept
Dir, Radar Div

BLOCK DIAGRAM
MODULATOR SUBASSEMBLY TEST SETUP

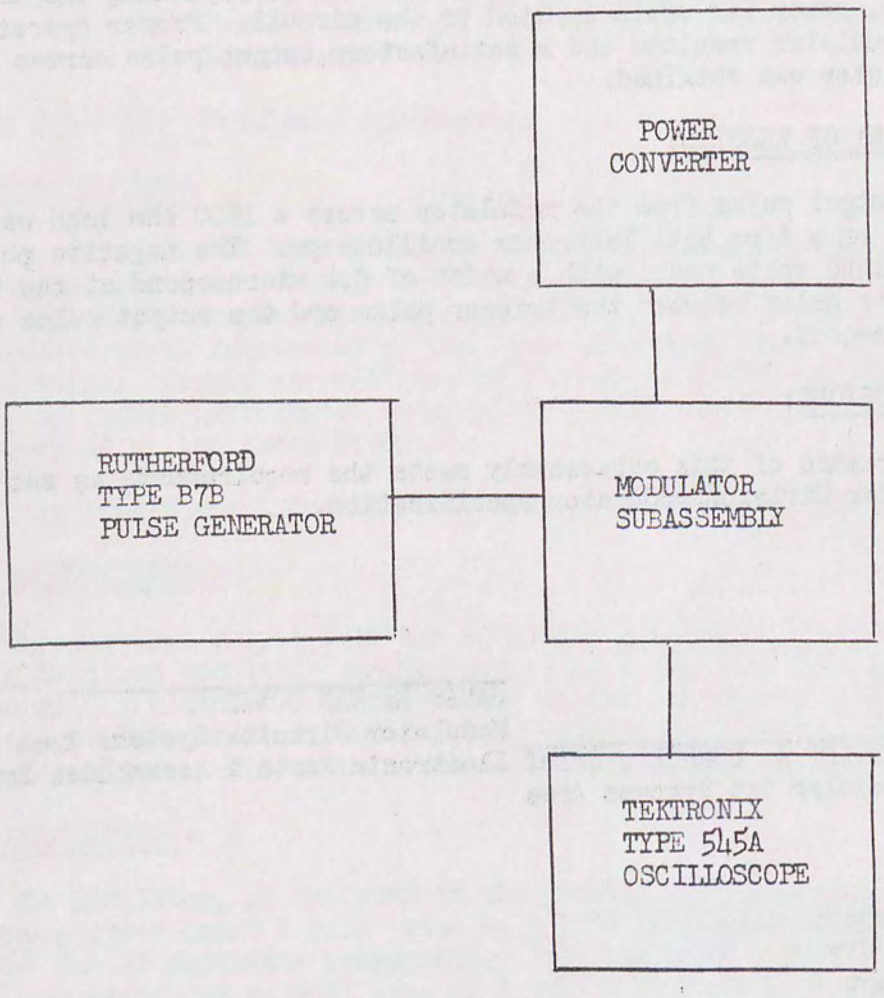
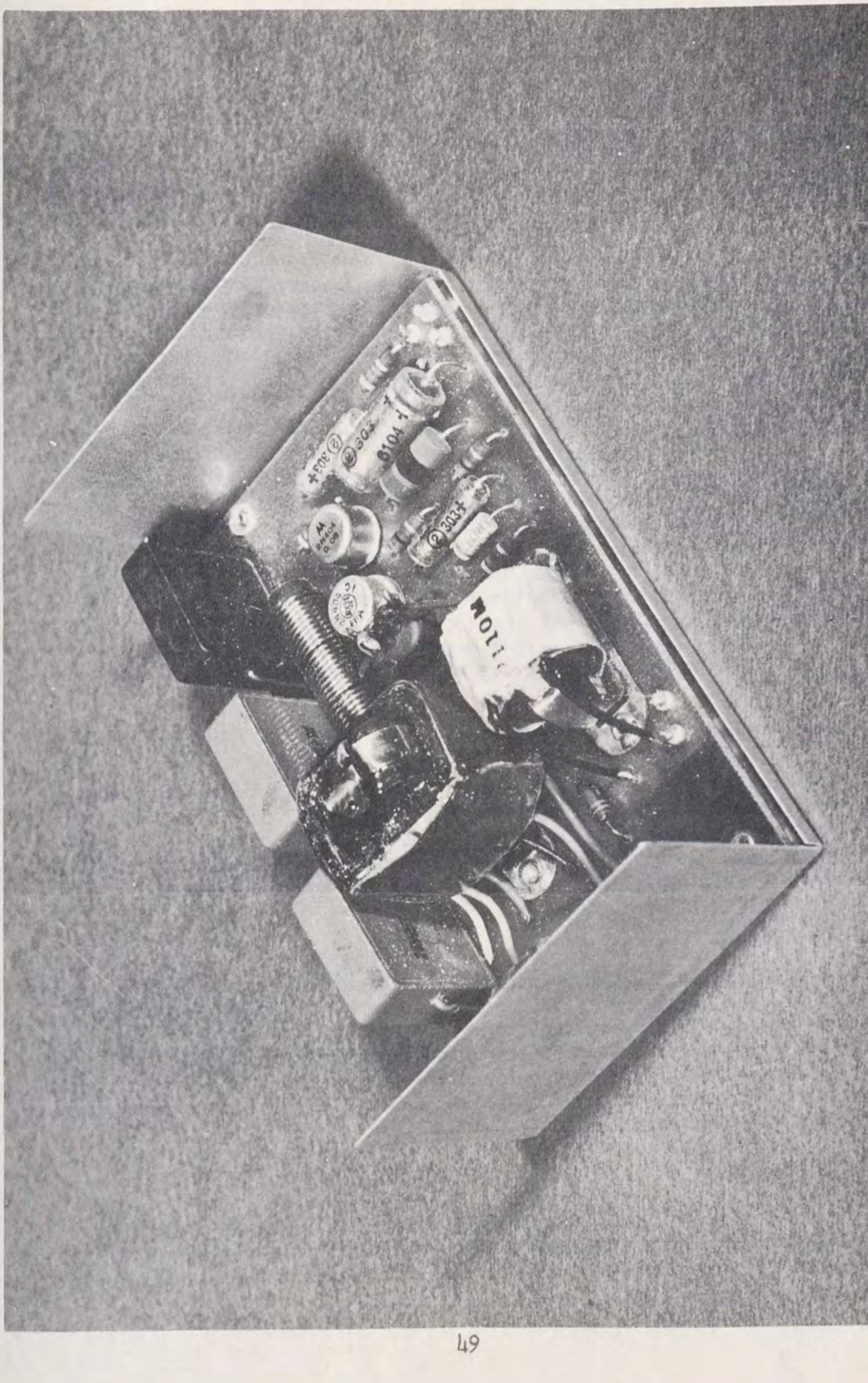


Figure 2



M-61-1004

APPENDIX VI

MODULAR CIRCUIT SYSTEMS AREA
ELECTRONIC PARTS AND ASSEMBLIES BRANCH
ELECTRONIC PARTS AND MATERIALS DIVISION
ELECTRONIC COMPONENTS DEPARTMENT

SIGRA/SL-PEP
3G26-20-06-001-03

8 September 1961

TEST REPORT #55-4

MEMORANDUM FOR: Chief, Electronic Parts and Assemblies Branch, Electronic Parts and Materials Division, Electronic Components Department, USASRDL

S U B J E C T : Trigger Generator, AN/PPS-6

1. INTRODUCTION:

The objective of this EP&A effort is to provide a modularized, printed wiring version (MARK IV) of the radar set. This model is to have electrical characteristics comparable to those of the experimental handwired model fabricated by the Radar Division. This effort includes adjustments, circuit corrections, or changes in component values necessary to insure performance in compliance with technical requirements as supplied by the Radar Division.

This report specifically covers effort on the trigger generator subassembly.

2. DESCRIPTION:

The trigger generator subassembly, as designed in the printed wiring version, consists of one circuit board $5\frac{1}{4}$" long by 1 5/8" wide. The circuit board is contained in an aluminum case 5 1/2" long by 1 7/8" wide by 3/4" thick. Total weight of this subassembly is 6.0 oz. Figure 1 is a photograph of the trigger generator unit with cover removed.

3. REQUIREMENTS:

As outlined in the Radar Division specification for the ZIPPO trigger generator, this subassembly is required to generate two output pulses each having a nominal peak amplitude of -7 volts. These pulses must occur within the flat-top portion of the input synchronizing square wave. The time delay between the pretrigger and the trigger must be 4.0 microseconds. Tolerances on amplitude, wave shape and delay were verbally agreed upon with the Radar Division.

4. PROCEDURE:

As noted in the Block Diagram (Figure 2), the negative 8 volts dc and the 2 kc synchronizing square wave required by the trigger generator were supplied by the power converter (see EP&A report #55-1). The output wave shape, amplitude and delay were monitored on a Textronix Oscilloscope Model 545A.

5. SUMMARY OF RESULTS:

Initial tests resulted in a pre-trigger pulse amplitude of -7.8 v, having a pulse width of 0.78 microseconds, and a delayed trigger pulse of -7.8v, 1.1 microseconds. As shown in A, of Figure 3, trigger pulse occurred 100 microseconds after the leading edge of the synchronizing square wave. The time delay between the pre-trigger pulse and the trigger pulse is set by the trigger delay control. Initial range of delay control was found to be from 2.0 to 3.5 microseconds. As the required time delay is 4.0 microseconds, this range was not acceptable. Increasing the value of the fixed resistor in series with the delay control from 18K ohms to 27K ohms provided a range of from 3.4 to 4.6 microseconds as shown in B1 and B2 of Figure 3. This range is centered around the desired 4.0 microsecond delay.

6. CONCLUSIONS:

Performance of this subassembly meets the requirements as set forth in the Radar Division Trigger Generator Specification.

Prepared by: ____________
J. VAN DOVER
Elec Dev Technician

Approved: ____________
R. A. GERHOLD, Chief
Modular Ckt Systems Area

3 Attachments

Copy furnished:
Dir, EC Dept, USASRDL
Dir, EP&MDiv, USASRDL
Dir,RadarDiv, USASRDL

BLOCK DIAGRAM

TRIGGER GENERATOR SUBASSEMBLY TEST SETUP

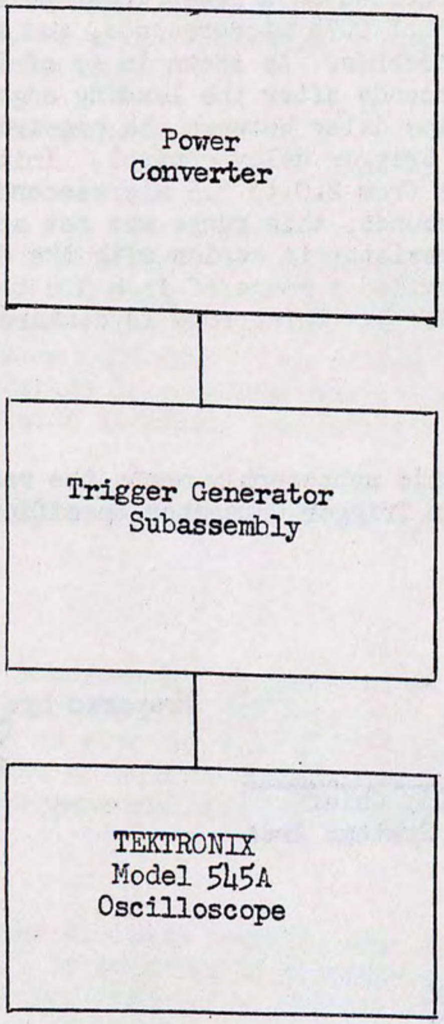
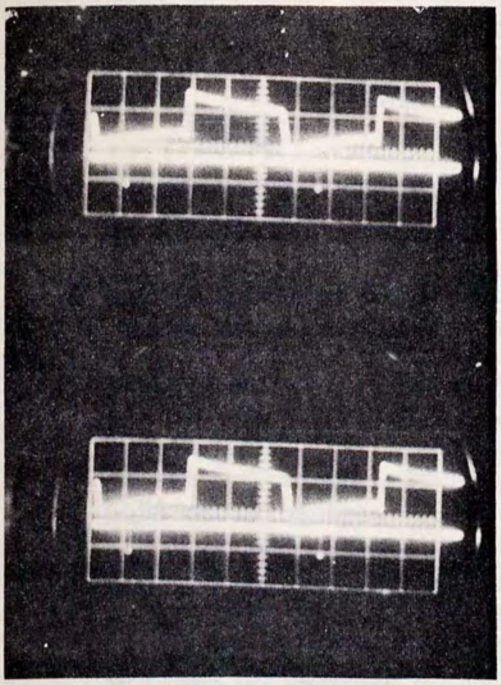


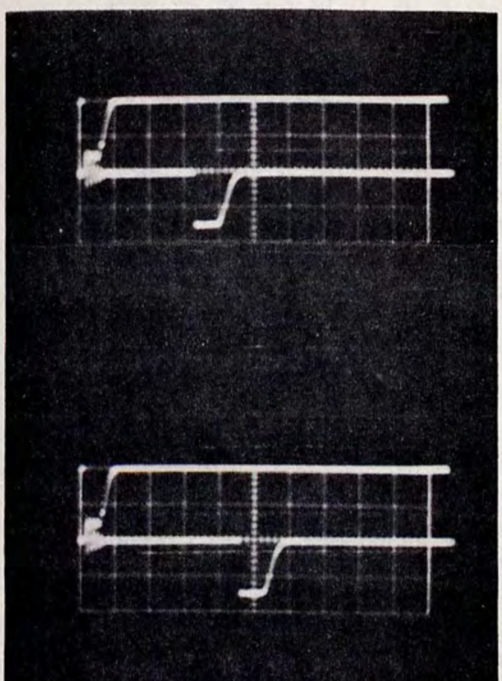
Figure 2



A1 Top Trace: Input square wave
Scope Sensitivity
Hor. = 0.1 ms/cm
Vert.= 20v/cm

Bottom Trace: Pretrigger Pulse
Scope Sensitivity
Hor. = 0.1 ms/cm
Vert.= 10v/cm

A2 Same as A1.



B1 Top Trace: Pre-trigger

Bottom Trace: Trigger
(Min. Delay Time)
Scope Sensitivity (All traces)
Hor. = 1.0 microseconds/cm
Vert.= 5v/cm

B2 Top Trace: Pre-trigger

Bottom Trace: Trigger
(Max. Delay Time)
Scope Sensitivity (Same as B1)

Figure 3

APPENDIX VII

EQUIPMENT INTEGRATION AREA
MODULAR ASSEMBLIES BRANCH
ELECTRONIC PARTS & MATERIALS DIVISION
ELECTRONIC COMPONENTS DEPARTMENT

SIGRA/SL-PEP
3D58-05-001-05

TEST REPORT #55-6

8 May 1962

MEMORANDUM FOR: Chief, Modular Assemblies Branch, Electronic Parts and Materials Division, Electronic Components Department, USASRDL

S U B J E C T : IF Amplifier, AN/PPS-6

1. INTRODUCTION:

The objective of this MA Br effort is to provide a modularized, printed wiring version (MARK IV) of the AN/PPS-6 radar set. This model is to have electrical characteristics comparable to those of the experimental hand-wired model fabricated by the Radar Division. This effort includes adjustments, circuit corrections, or changes in component values necessary to insure performance in compliance with technical requirements as supplied by the Radar Division.

This report specifically covers effort on the Intermediate Frequency (I.F.) Amplifier subassembly.

2. DESCRIPTION:

The AN/PPS-6 I.F. subassembly as designed in the printed wiring version consists of one circuit board 5 1/4" long by 1 5/8" wide.

The overall subassembly consists of two I.F. stages and three video stages.

The circuit board is contained in an aluminum case 5 1/2" by 1 7/8" by 3/4". Total weight of this subassembly is 3.7 oz.

Figure 1 shows the I.F. amplifier unit with cover removed.

3. REQUIREMENTS:

As outlined in the Radar Division specification for the I.F. subassembly, the I.F. proper (i.e., the first two stages of the subassembly) should have a center frequency of approximately 30 megacycles, and a bandpass at the 3db points of at least 7 megacycles. The overall gain for the subassembly, including the two I.F. stages and the three video stages, should be at least 90 db at an output level of one volt.

An additional requirement, peculiar to this I.F. amplifier, is that the circuit must show no instability (tendency to oscillate) when the input is open circuited.

4. PROCEDURE:

The I.F. subassembly is tested in two steps. First, the center frequency, bandwidth and the open input circuit stability of the I.F. amplifier proper are determined. Then the gain of the overall I.F. subassembly is measured.

Step one is accomplished by feeding the signal from a Telonic Industries type H3 sweep Generator (See block diagram, figure 2) pre-set to sweep thru the frequency band of interest, into the input of the AN/PPS-6 I.F. amplifier. The output is monitored at the second detector through a 10,000 ohm insulating resistor on a tektronix model 545A oscilloscope. The I.F. proper was also checked for open circuit stability by observing d.c. level shift at the detector output. Figure 3 is an oscillogram demonstrating the I.F. frequency response.

Step two consisted of measuring the overall gain of the I.F. sub-assembly. This was accomplished with an R.F. signal provided by a Hew-lett Packard model 608A Signal Generator modulated by a Rutherford model B7B pulse generator, and adjusted to the I.F. center frequency. The pulsed R.F. signal was first fed through a diode to the tektronix Os-cilloscope (See figure 4A) and the level adjusted to provide a one volt signal at the scope terminals. The overall gain of the I.F. amplifier is determined from the attenuation required in the signal generator out-put to again provide a one volt signal level at the scope terminals with the I.F. amplifier connected into the circuit. (See figure 4B).

5. SUMMARY OF RESULTS:

The two major problems encountered during the checkout of the I.F. amplifier subassembly were: (1) instability under open input circuit conditions, and (2) insufficient bandwidth. The first I.F. subassembly, although working farily well with input applied, would oscillate when the input was open circuited. Some of the possible causes of this in-stability were: location of the ground returns and bypass capacitors, insufficient shielding, value of the neutralizing capacitor, and general layout of the high frequency section of the board.

A second model incorporating some of these considerations was con-structed, but proved only slightly better then the first attempt. For the third and final model the layout was completely revised with a view toward eliminating all unwanted coupling, improving the intrastage shielding, providing shorter, more direct ground lead, and providing a single ground point for each stage.

This third model provided a gain of 105 db (or 15 db more than the specified 90 db) at an output of one volt and had the required open input circuit stability. However the bandwidth failed to meet the requirements of 7 megacycles at the 3 db points. Adding a 220 ohm low-noise resistor in shunt with the secondary of the second I.F. transformer increased bandwidth at the 3 db points to the required 7 megacycles without adversely affecting the overall gain of the I.F. subassembly.

6. CONCLUSIONS:

Performance of this subassembly meets the requirements as set forth in the Radar Division I.F. amplifier specification.

Prepared by:
JAMES K. VAN DOVER
Project Engineer

Approved by:
NORMAN F. BECHTOLD, Chief
Equipment Integration Area
Modular Assemblies Branch
Elec Pts & Matls Division

Copy furnished
Dir, EP&M Div
Dir, EC Dept
M&R FU #1

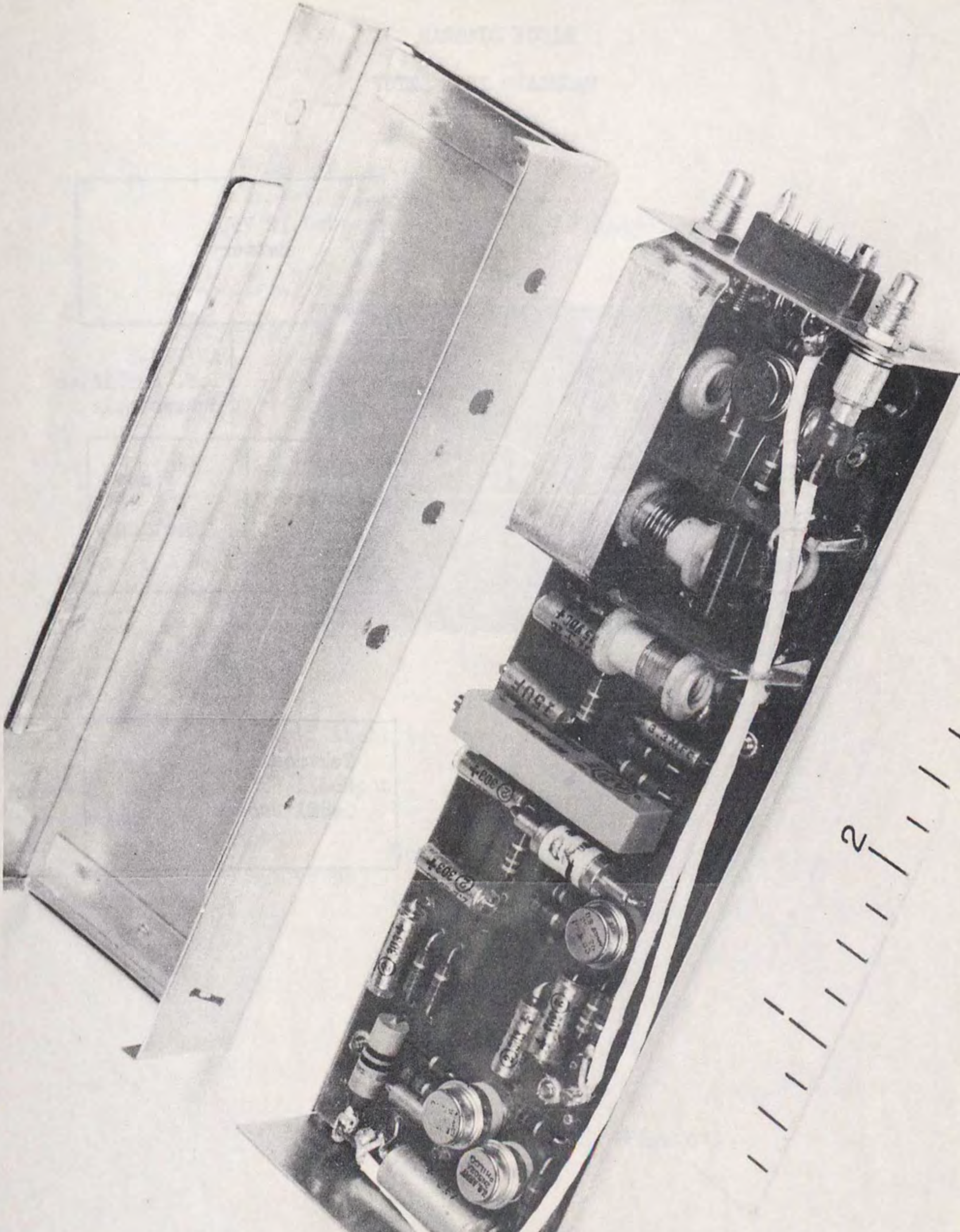


Fig. 1

BLOCK DIAGRAM

PASSBAND TEST SETUP

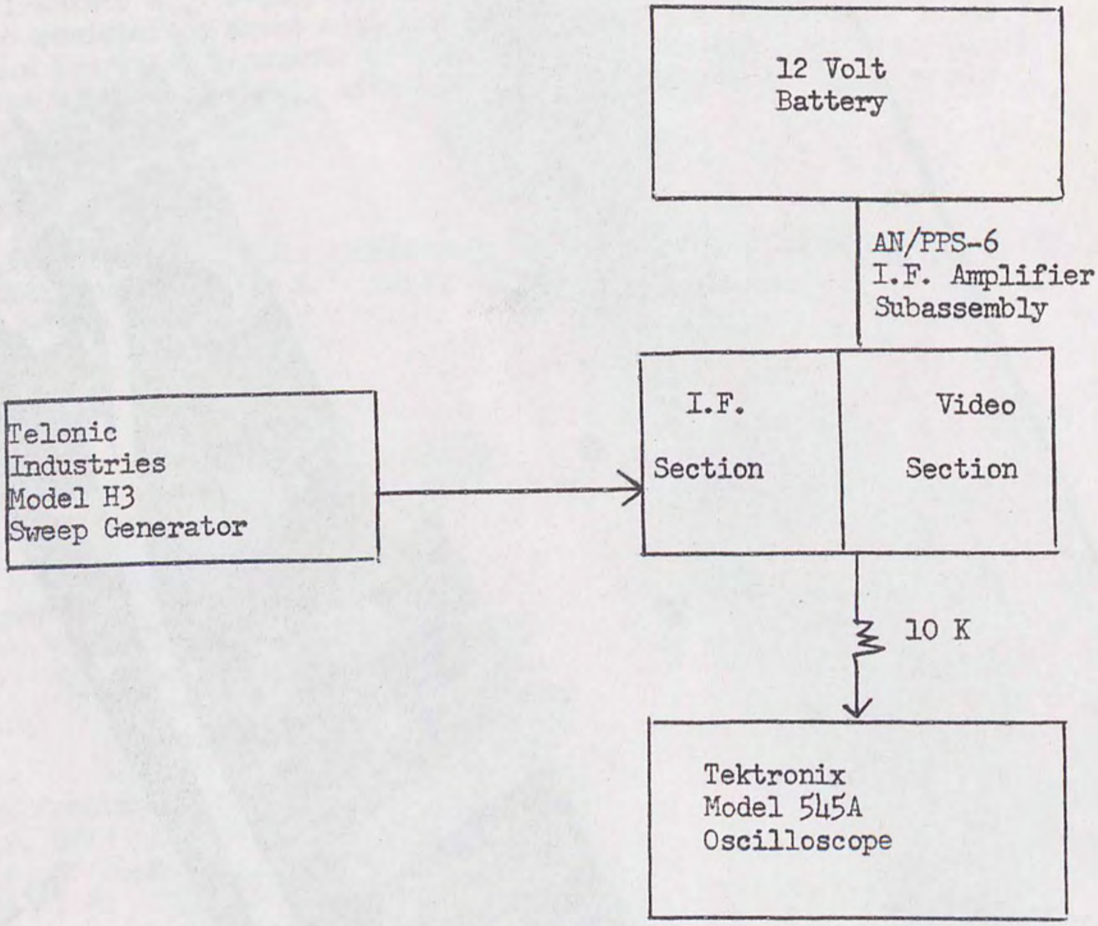
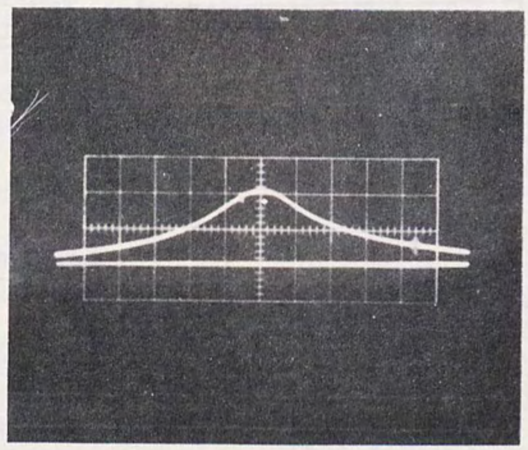


FIGURE 2

IF Response
Center Frequency 28.0 Megacycles



IF Amplifier Frequency Response

DC input	12v
AGC	8v

Scope Horz. 2 Megacycle/cm

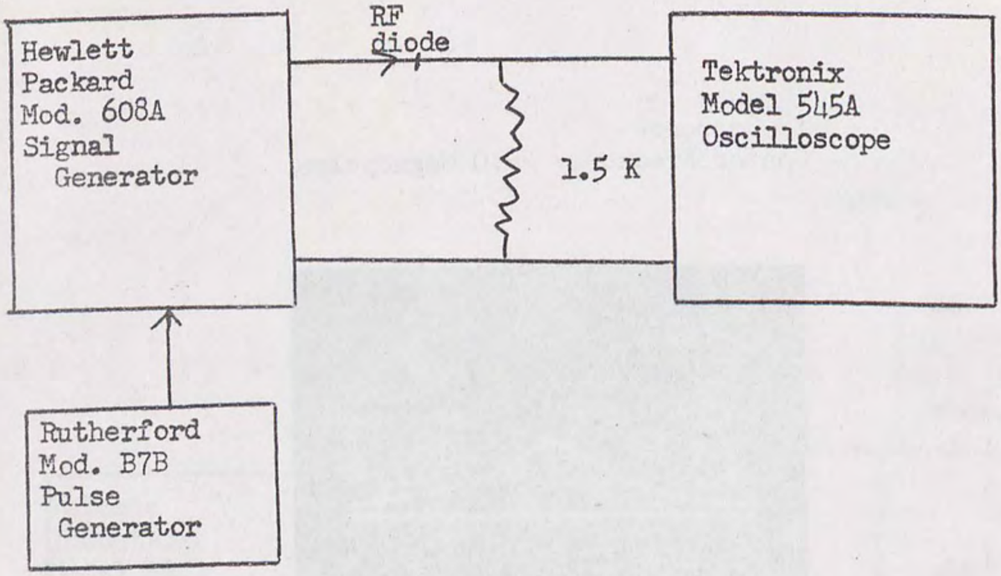
Scope Vert. .05 volt/cm

Figure 3

BLOCK DIAGRAM

OVERALL GAIN MEASUREMENT

A



B

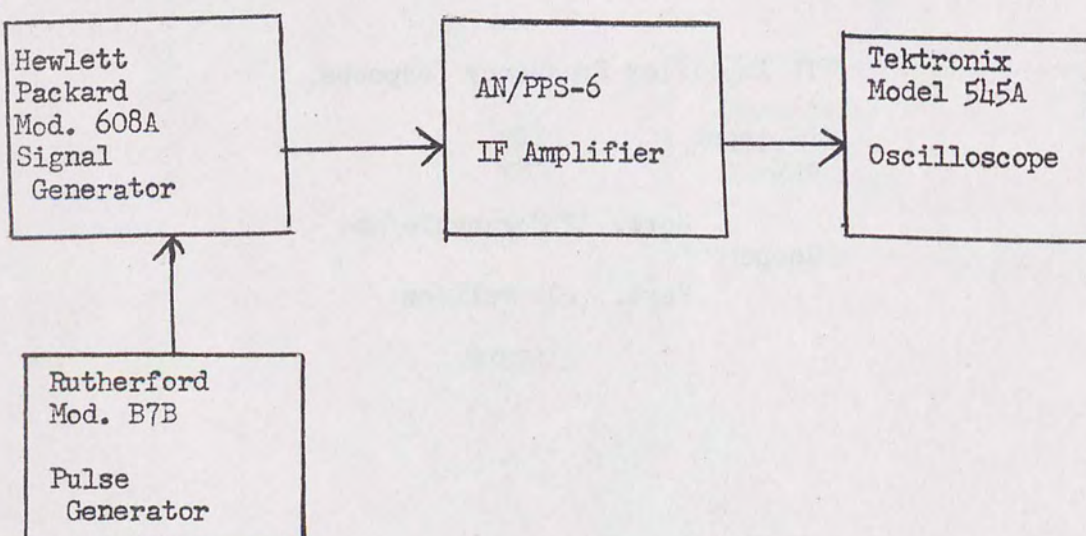


FIGURE 4

DISTRIBUTION LIST

No. Copies	Addressee
3	Commanding General U. S. Army Electronics Command ATTN: AMSEL-AD Fort Monmouth, New Jersey
1	Office of the Assistant Secretary of Defense (Research & Engineering) ATTN: Technical Library Room 3E1065, The Pentagon Washington 25, D. C.
2	Chief of Research and Development Department of the Army Washington 25, D. C.
1	Chief, United States Army Security Agency ATTN: ACofS, G4 (Technical Library) Arlington Hall Station Arlington 12, Virginia
1	Commanding Officer U. S. Army Electronics Research and Development Activity ATTN: Technical Library Fort Huachuca, Arizona
1	Commanding Officer U. S. Army Electronics Research and Development Activity ATTN: SELWS-AJ White Sands, New Mexico
1	Commanding Officer U. S. Army Electronics Research Unit P. O. Box 205 Mountain View, California
1	Commanding Officer U. S. Army Electronics Materiel Support Agency ATTN: SELMS-ADJ Fort Monmouth, New Jersey
1	Commanding General U. S. Army Satellite Communications Agency ATTN: Technical Documents Center Fort Monmouth, New Jersey
1	Director U. S. Army Engineer Research and Development Laboratories ATTN: STINFO BRANCH Fort Belvoir, Virginia
1	Commanding Officer U. S. Army Chemical Warfare Laboratories ATTN: Technical Library, Building 330 Army Chemical Center, Maryland
1	Commanding Officer Harry Diamond Laboratories Connecticut Ave. & Van Ness St. N.W. Washington 25, D. C.
2	Headquarters, United States Air Force ATTN: AFCIN Washington 25, D. C.
1	Rome Air Development Center ATTN: RAALD Griffiss Air Force Base New York
1	Headquarters Ground Electronics Engineering Installation Agency ATTN: ROZMEL Griffiss Air Force Base New York
2	Commanding General U. S. Army Materiel Command ATTN: R&D Directorate Washington, D. C. 20315

DISTRIBUTION LIST
(Continued)

No. Copies	Addressee
1	Aeronautical Systems Division ATTN: ASNXRR Wright-Patterson Air Force Base Ohio
1	U. S. Air Force Security Service ATTN: ESD San Antonio, Texas
1	Headquarters Strategic Air Command ATTN: DOCE Offutt Air Force Base, Nebraska
1	Headquarters Research & Technology Division ATTN: RTH Bolling Air Force Base Washington 25, D. C.
1	Air Proving Ground Center ATTN: PGAPI Eglin Air Force Base, Florida
2	Air Force Cambridge Research Laboratories ATTN: CRXL-R L. G. Hanscom Field Bedford, Massachusetts
2	Electronic Systems Division (AFSC) Scientific and Technical Information Division (ESTI) L. G. Hanscom Field Bedford, Massachusetts
1	AFSC Scientific/Technical Liaison Office U. S. Naval Air Development Center Johnsville, Pa.

No. Copies	Addressee
1	Chief of Naval Research ATTN: Code 427 Department of the Navy Washington 25, D. C.
1	Bureau of Ships Technical Library ATTN: Code 312 Main Navy Building, Room 1528 Washington 25, D. C.
1	Chief, Bureau of Ships ATTN: Code 454 Department of the Navy Washington 25, D. C.
1	Chief, Bureau of Ships ATTN: Code 686B Department of the Navy Washington 25, D. C.
1	Director U. S. Naval Research Laboratory ATTN: Code 2027 Washington, D. C. 20390
1	Commanding Officer & Director U. S. Navy Electronics Laboratory ATTN: Library San Diego 52, California
1	Commander U. S. Naval Ordnance Laboratory White Oak Silver Spring 19, Maryland
20	Commander Defense Documentation Center ATTN: TISIA Cameron Station, Building 5 Alexandria, Virginia, 22314

DISTRIBUTION LIST
(Continued)

No. Copies	Addressee	No. Copies	Addressee
1	USAEIRDL Liaison Officer U. S. Army Tank-Automotive Center Warren, Michigan 48090	1	Chief, Pacific Field Office U. S. Army Electronics Materiel Support Agency APO 958 San Francisco, California
1	USAELRDL Liaison Officer Naval Research Laboratory ATTN: Code 1071 Washington, D. C. 20390	1	Technical Director SELRA/CT Headquarters, USAELRDL
1	USAELRDL Liaison Officer Massachusetts Institute of Technology Building 26, Room 131 77 Massachusetts Avenue Cambridge 39, Massachusetts	1	USAELRDA-White Sands Liaison Office SELRA/LNW, USAELRDL
1	USAELRDL Liaison Office Aeronautical Systems Division ATTN: ASDL-9 Wright-Patterson Air Force Base Ohio 45433	1	AFSC Scientific/Technical Liaison Office SELRA/LNA, USAELRDL
1	U. S. Army Research Liaison Office Lincoln Laboratory P. O. Box 73 Lexington, Massachusetts	1	Marine Corps Liaison Office SELRA/LNR, USAELRDL
1	USAEIRDL Liaison Officer Rome Air Development Center ATTN: RAOL Griffiss Air Force Base, N. Y. 13442	2	USACDC Liaison Office SELRA/LNF, USAELRDL
1	USAEIRDL Liaison Officer U. S. Army Combat Developments Command CDCLN-EL Fort Belvoir, Virginia	1	Commanding Officer U. S. Army Security Agency Processing Center Vint Hill Farms Station Warrentown, Virginia 22186
1	Director U. S. Army Engineer Geodesy, Intelligence and Mapping Research & Development Agency ATTN: ENGGM-SS Fort Belvoir, Virginia	2	Chief, Technical Information Division Headquarters, USAEIRDL
		1	Chief Scientist U. S. Army Electronics Command ATTN: AMSEL-SC Fort Monmouth, N. J.
		1	USAEIRDL Technical Documents Center SELRA/ADT, Hexagon
		1	Director, Electronic Components Department SELRA/P, USAELRDL

DISTRIBUTION LIST
(Continued)

No. Copies	Addressee
1	Director, Electronic Parts & Materials Division SELRA/PE, USAELRDL
1	Records Holding Area SELRA/ADO-RHA, USAELRDL
48	Chief, Modular Assemblies Br. SELRA/PEP, USAELRDL

Army-Ft Monmouth, NJ-MON 1728-64

AD ______________ Div. ______________

UNCLASSIFIED

Army Electronics Research and Development Laboratories, Fort Monmouth, N. J.
ASSEMBLY DESIGN OF MINIATURE LIGHTWEIGHT HANDHELD RADAR SET AN/PPS-6, by Harry H. French. September 1963, 60p. incl. illus. (AELRDL Technical Report 2421) (DA Task 3A99-15-002-03) Unclassified report

This report covers in-house development to provide two modularized, printed wiring models of the (Mark IV) Lightweight Handheld Radar Set (AN/PPS-6). The initial model included packaging design using the latest state-of-the-art techniques for miniaturized, lightweight, ruggedized, electronic modules to meet test and operational requirements. The second model was designed to contain additional temperature-compensating circuits to further miniaturize the equipment, and to modify the package design for greater ease of maintenance.

1. Radar Set (Mark IV) AN/PPS-6
2. Miniature, Handheld, Lightweight Radar

I. French, Harry H.
II. Army Electronics Research & Development Laboratories, Fort Monmouth, N. J.
III. DA Task 3A99-15-002-03

UNCLASSIFIED

AD ______________ Div. ______________

UNCLASSIFIED

Army Electronics Research and Development Laboratories, Fort Monmouth, N. J.
ASSEMBLY DESIGN OF MINIATURE LIGHTWEIGHT HANDHELD RADAR SET AN/PPS-6, by Harry H. French. September 1963, 60p. incl. illus. (AELRDL Technical Report 2421) (DA Task 3A99-15-002-03) Unclassified report

This report covers in-house development to provide two modularized, printed wiring models of the (Mark IV) Lightweight Handheld Radar Set (AN/PPS-6). The initial model included packaging design using the latest state-of-the-art techniques for miniaturized, lightweight, ruggedized, electronic modules to meet test and operational requirements. The second model was designed to contain additional temperature-compensating circuits to further miniaturize the equipment, and to modify the package design for greater ease of maintenance.

1. Radar Set (Mark IV) AN/PPS-6
2. Miniature, Handheld, Lightweight Radar

I. French, Harry H.
II. Army Electronics Research & Development Laboratories, Fort Monmouth, N. J.
III. DA Task 3A99-15-002-03

UNCLASSIFIED

AD ______________ Div. ______________

UNCLASSIFIED

Army Electronics Research and Development Laboratories, Fort Monmouth, N. J.
ASSEMBLY DESIGN OF MINIATURE LIGHTWEIGHT HANDHELD RADAR SET AN/PPS-6, by Harry H. French. September 1963, 60p. incl. illus. (AELRDL Technical Report 2421) (DA Task 3A99-15-002-03) Unclassified report

This report covers in-house development to provide two modularized, printed wiring models of the (Mark IV) Lightweight Handheld Radar Set (AN/PPS-6). The initial model included packaging design using the latest state-of-the-art techniques for miniaturized, lightweight, ruggedized, electronic modules to meet test and operational requirements. The second model was designed to contain additional temperature-compensating circuits to further miniaturize the equipment, and to modify the package design for greater ease of maintenance.

1. Radar Set (Mark IV) AN/PPS-6
2. Miniature, Handheld, Lightweight Radar

I. French, Harry H.
II. Army Electronics Research & Development Laboratories, Fort Monmouth, N. J.
III. DA Task 3A99-15-002-03

UNCLASSIFIED

AD ______________ Div. ______________

UNCLASSIFIED

Army Electronics Research and Development Laboratories, Fort Monmouth, N. J.
ASSEMBLY DESIGN OF MINIATURE LIGHTWEIGHT HANDHELD RADAR SET AN/PPS-6, by Harry H. French. September 1963, 60p. incl. illus. (AELRDL Technical Report 2421) (DA Task 3A99-15-002-03) Unclassified report

This report covers in-house development to provide two modularized, printed wiring models of the (Mark IV) Lightweight Handheld Radar Set (AN/PPS-6). The initial model included packaging design using the latest state-of-the-art techniques for miniaturized, lightweight, ruggedized, electronic modules to meet test and operational requirements. The second model was designed to contain additional temperature-compensating circuits to further miniaturize the equipment, and to modify the package design for greater ease of maintenance.

1. Radar Set (Mark IV) AN/PPS-6
2. Miniature, Handheld, Lightweight Radar

I. French, Harry H.
II. Army Electronics Research & Development Laboratories, Fort Monmouth, N. J.
III. DA Task 3A99-15-002-03

UNCLASSIFIED