A PULSE AMPLIFIER USING INTEGRATED CIRCUITS

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U.S. ATOMIC ENERGY COMMISSION
CONTRACT AT(29-1)-1106

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Printed in the United States of America
Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U. S. Department of Commerce
Springfield, Virginia 22151
Price: Printed Copy $3.00; Microfiche $0.65

23 August 1967

RFP-964
UC-37 INSTRUMENTS
TID-4500

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CONTENTS

ACKNOWLEDGMENT

The author would like to thank Mr. C. W. Nordin for the printed circuit layout and construction of the amplifier described in this report.

A Pulse Amplifier Using Integrated Circuits

W. H. Tyree

Abstract. A 0-10 volt pulse amplifier utilizing low cost linear and logic integrated circuits and plastic encased transistors was built. The unit had a maximum gain of 350, noise input of 15 microvolts, adjustable risetime, and a coincident logic signal.

INTRODUCTION

Several companies have made available for industrial use medium gain, high frequency, linear integrated circuits. These are available for as low as $2.50 per unit. The types of linear integrated circuits which were available through local electronic supply were compared for frequency response, gain, simplicity of installation, and unit cost. The Westinghouse Type WC-1146T was chosen for this application.

DESCRIPTION

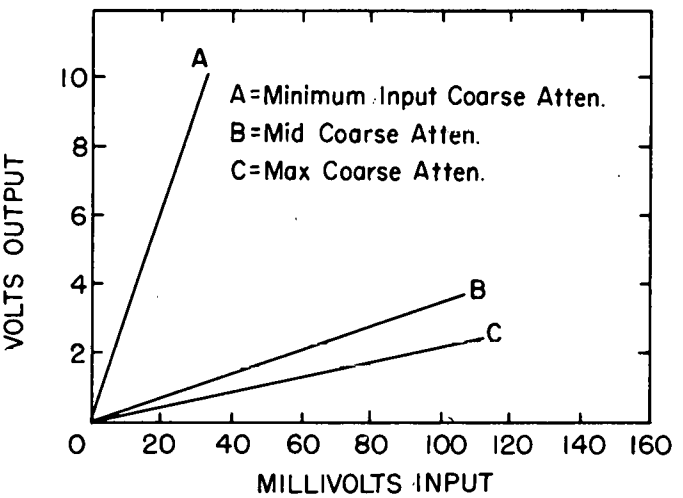
The amplifier (Figure 1) was designed for use as a general purpose nuclear pulse amplifier. The input and output pulse levels and polarities conform to the guides set for the AEC module series. A logic signal (Figure 2) was included for use with a Nuclear Data ND-120 multichannel pulse height analyzer.

The amplifier circuit includes an 11-step course-control attenuator and a 10-turn wire-wound fine control attenuator at the input to the integrated circuit. The fine control allows a continuous adjustment of the voltage level with the maximum input voltage determined by the coarse control position. A pulse integrator control was connected to pin 7 of the integrated circuit for applications requiring optimum pulse shape. The output of the WC-1146T was taken as a negative pulse from pin 6 of the integrated circuit. An amplifier stage Q2 produced an output voltage swing capability of greater than 10 volts. An additional stage Q3 was included in the amplifier to decouple the amplifier output stage from a signal line and provide a low impedance driving circuit for external equipment.

The linear signal was also used to produce a coincident pulse with a uniform pulse waveform. The emitter follower Q3 in the linear amplifier was connected to another emitter follower Q4 which has an output level control. A trigger amplifier Q5 was located between the emitter follower Q4 and the trigger circuit Q6 to improve the trigger sensitivity to low amplitude pulses from the amplifier. The pulse from the logic circuit Q6, a univibrator, was approximately 1.5 to 2 microseconds long. Emitter followers Q7 and Q8 were used to decouple the trigger circuit from the output logic lines.

ELECTRICAL CHARACTERISTICS

The amplifier linearity was tested over a wide range of input pulse amplitudes. The following curves demonstrated the overall linearity.



The noise output voltage from the amplifier with respect to the input is

$$E_{noise} = \frac{E_{out}}{A}$$

$A = 330$
$E_{out} = 4 \times 10^{-3}$
E_{noise} = 15 microvolts referred to the input.

The maximum gain of the amplifier was

$$A = \frac{E_{out}}{E_{in}} = 350$$

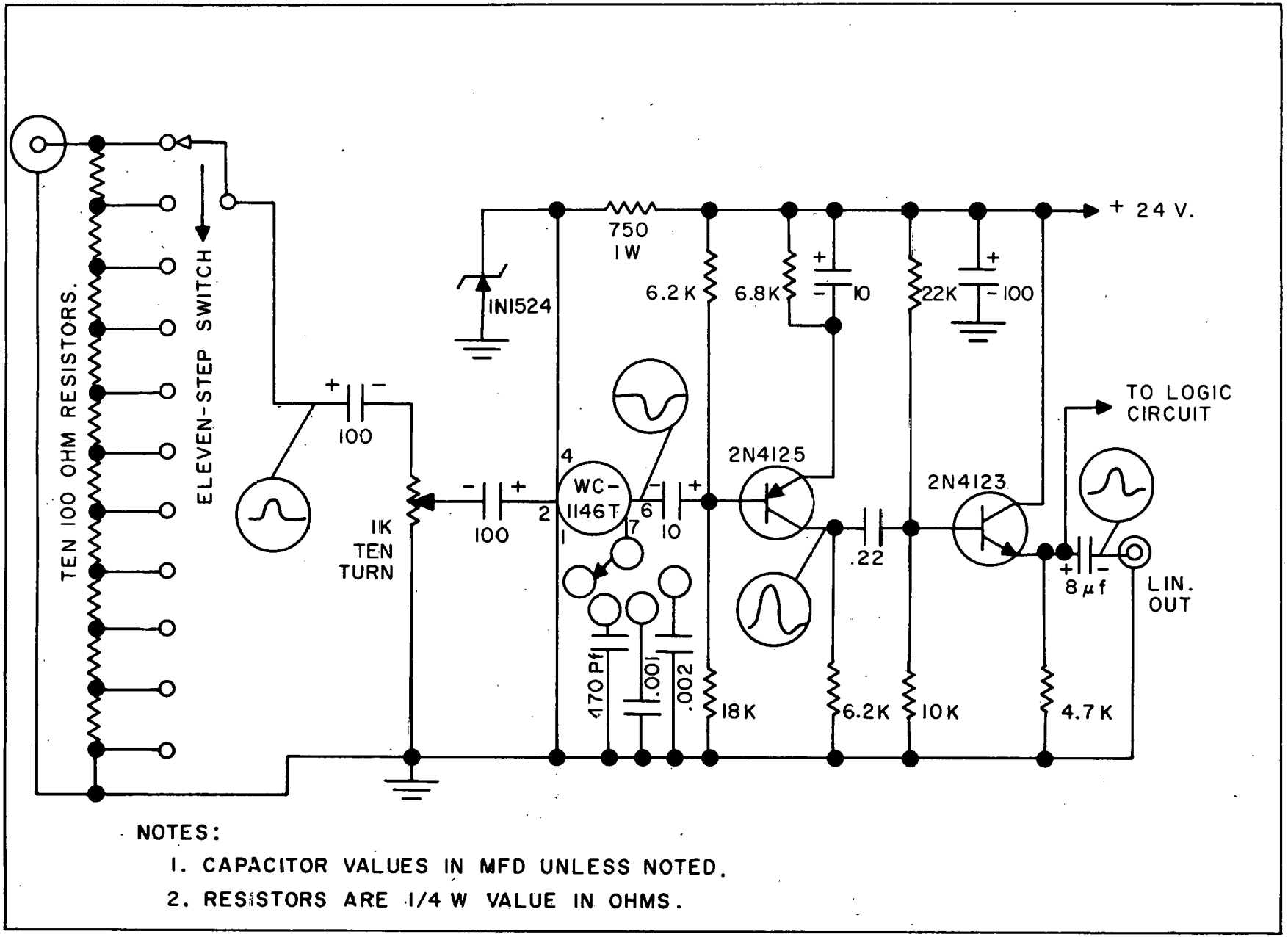
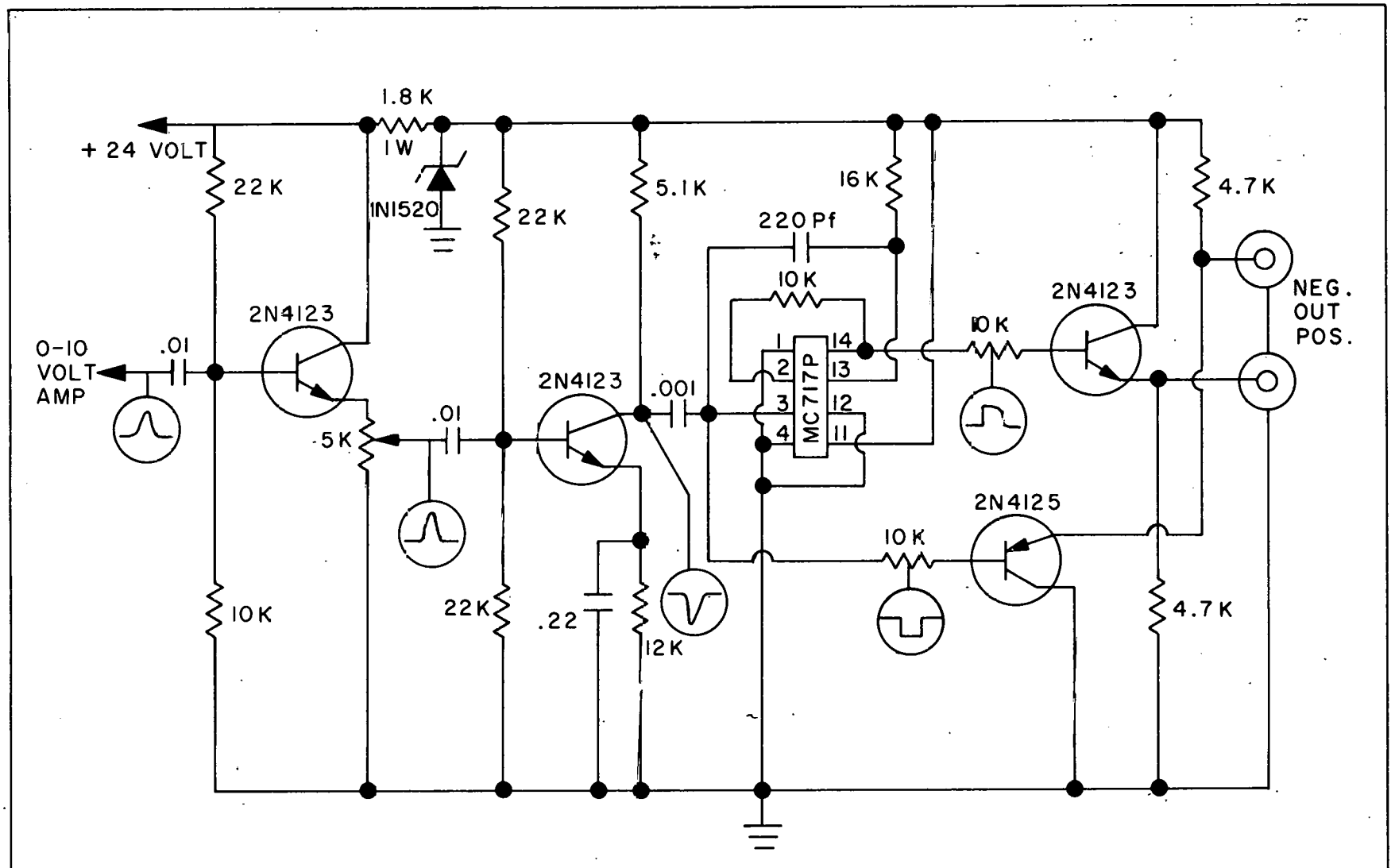


FIGURE 1. 0-10 Volt Amplifier.



NOTES:

1. CAPACITORS ARE MFD UNLESS NOTED.
2. RESISTORS ARE 1/4 W VALUE IN OHMS UNLESS NOTED.

FIGURE 2. Logic Circuit.

SUMMARY

A 0-10 volt amplifier which provides pulses for nuclear instrumentation was designed and built. The unit was housed in a single width AEC bin mounted module. The amplifier had a maximum gain of 350 with an input noise level referred to the input of 15 microvolts.

The amplifier featured a $3.45 linear integrated circuit and a $1.08 plastic encased quad 2 input gate logic circuit.

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