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Evaluation of a Transistorized Trigger Delay Unit

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EVALUATION OF A TRANSISTORIZED TRIGGER DELAY UNIT

SUMMARY

This report describes a transistorized trigger delay generator unit designed at the Technical Development Center of the Civil Aeronautics Administration. The evaluation of this unit was made while it was installed in a TI-440 scan-conversion unit, a system for converting radar information to a television bright display in the Indianapolis Airport control tower. The unit described herein operated without adjustment or component failure during the evaluation period of approximately three months.

INTRODUCTION

The Civil Aeronautics Administration airport surveillance radar (ASR) systems are designed for excellent display accuracy, particularly at short ranges. To accomplish this, a pretrigger is remoted from the radar transmitter site to the displays, in which adjustable delay circuits are provided to compensate accurately for the starting characteristics of the particular sweep amplifiers and deflection coils involved. The ASR-2 system has a pretrigger of approximately 2 microseconds and the ASR-1 and ASR-3 radar systems have a pretrigger of approximately 20 microseconds. Each display console furnished with these systems has a adjustable trigger delay circuit.

Occasionally, it is necessary to use a different type of display with an ASR system, or to use an ASR-2 console with an ASR-1 or ASR-3 radar, or vice versa. Under these conditions, an external trigger delay chassis or a modification of the existing circuitry is required to use the pretrigger that is supplied. Such is the case when the scan-conversion equipment, Model TI-440, is used with ASR radar systems. The TI-440 equipment does not have a built-in trigger delay of any type. Rather than use an external vacuum tube unit, it was decided to design a small transistorized unit which could be installed in the TI-440. Variations of this design could be used with other display equipment.

A photograph of the prototype unit installed in the TI-440 scan-conversion equipment is shown in Fig. 1. A schematic wiring diagram and parts list of the unit is shown in Fig. 2.

THEORY OF OPERATION

Referring to the schematic diagram, Fig. 2, the positive pretrigger is applied to a high-impedance input stage which is connected as an emitter-follower. This stage isolates the delay unit from the trigger source, and since it is an emitter-follower, its output is the same positive polarity as the input. See waveform 2, Fig. 2. The second and third transistor stages are of the switching type. These stages are connected as a monostable multivibrator. The output pulse width, waveform 3, Fig. 2, can be adjusted by the 100-kilohm potentiometer labeled "delay." The time constant of this delay circuit is determined by the 100-kilohm potentiometer and the 3,600-micro-microfarad capacitor. A delay range from 2 to 28 microseconds is possible. The network between the multivibrator and the amplifier circuits is a pulse-differentiating and clipping network. The delayed positive pulse is retained, while the undelayed negative pulse is clipped by action of the 1N27 diode. See waveform 4, Fig. 2. The fourth and fifth stages are NPN transistors which provide voltage amplification and a positive polarity output of approximately 8 volts. The output impedance is approximately 1,800 ohms since only a short lead is required to connect the unit to the TI-440. Feedback was provided throughout the unit to minimize output and delay variations with temperature.

RESULTS OF OPERATION

The unit, while installed in the TI-440 scan-conversion equipment located in the Indianapolis Airport control tower, was operated for approximately three months without requiring any readjustment. No component failures were encountered during this period.

The total current consumed by this unit is 14 milliamperes (ma). The required 12 volts was obtained from the negative 300-volt power supply in the TI-440 equipment through appropriate bleeder resistors. The only other connections required are the input and output trigger cables. The unit was mounted in the lower right-hand corner at the back of the writing sweep and marker generator chassis. This location simplified connections to the TI-440. The over-all size of this prototype unit is 4-by 4 inches by 1 inch. For a production unit, it appears the size could be reduced to 2-by 4 inches by 1 inch.

Following the operational evaluation, the trigger delay chassis was tested in a temperature chamber under conditions from 14° to 140° F. This temperature variation did not result in component breakdown or circuit malfunction during the test. The delay and output amplitude were maintained within 10 per cent of the values at 68° F. as the temperature was varied throughout the 14° to 140° F. range. Since the unit was located inside the scan-conversion unit during the evaluation, it was exposed to an operating temperature of approximately 123° F.

CONCLUSIONS

The laboratory and operational performance of this unit were found to be entirely satisfactory and it is indicated that it is feasible to use transistorized and miniaturized circuitry in CAA radar and communications equipment at this time. The techniques are especially applicable when modifications or additions are made to existing equipments where space is at a premium.

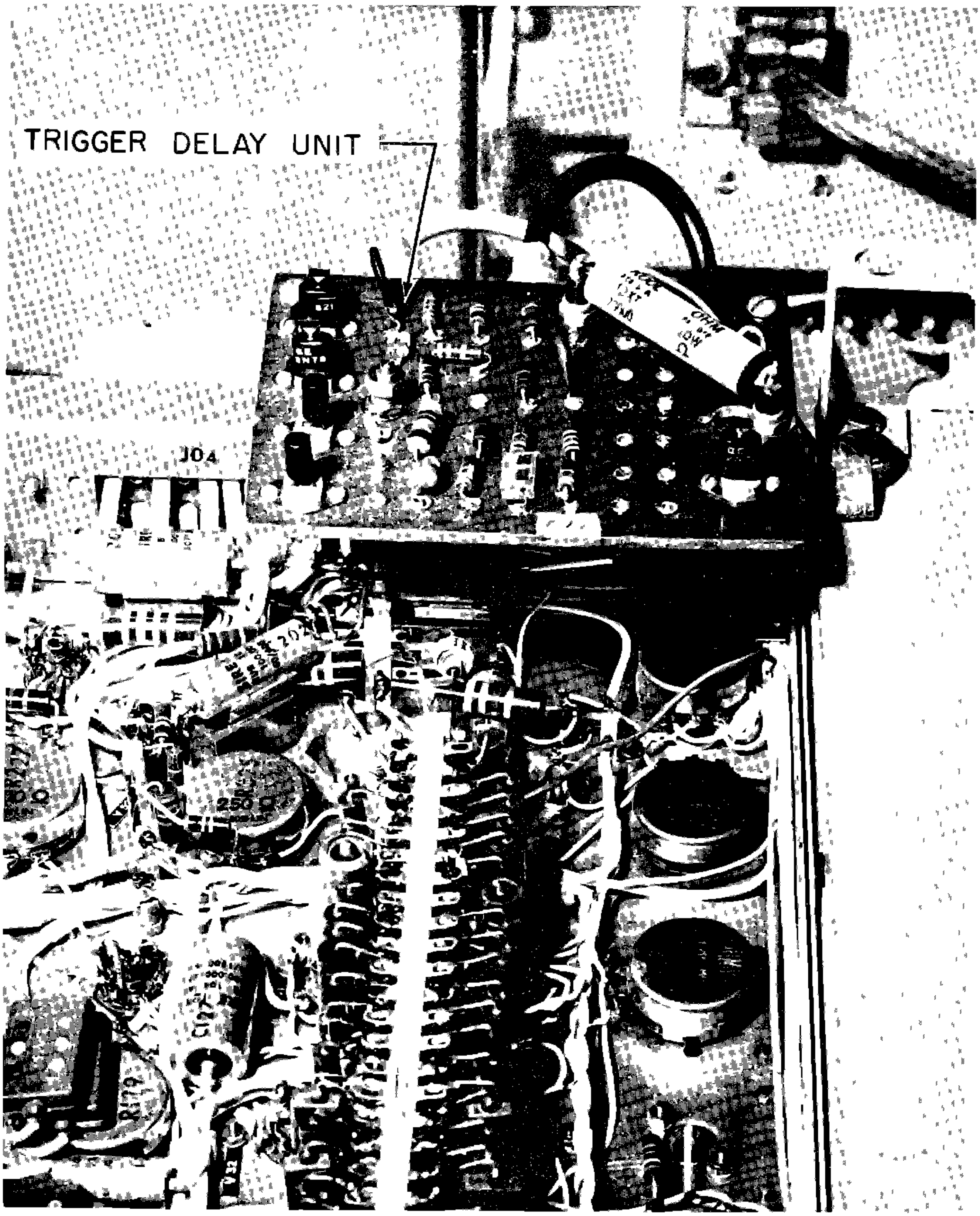

FIG 1 TRIGGER DELAY UNIT MOUNTING

TRANSISTOR TRIGGER DELAY FOR TI-440

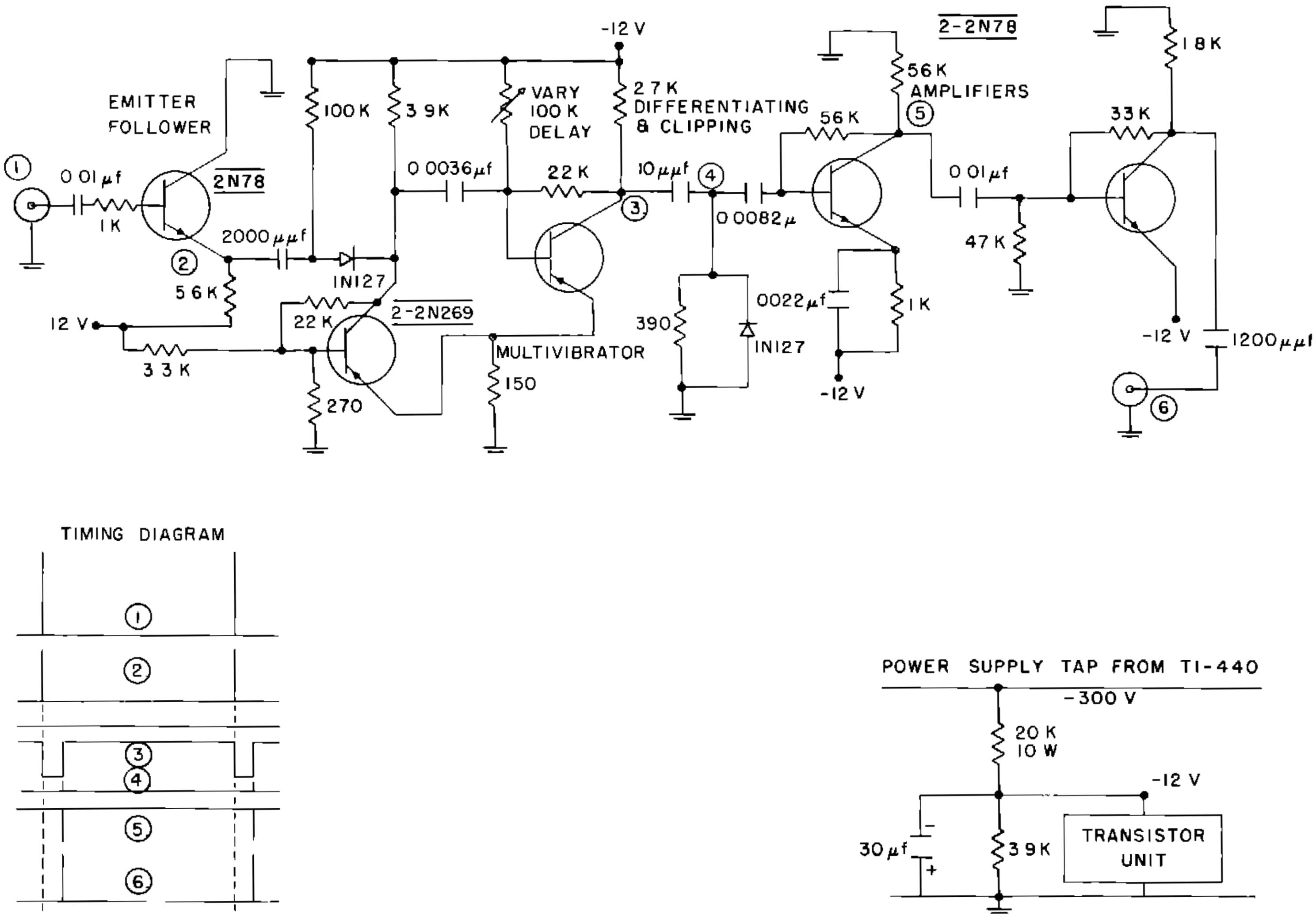

FIG 2 SCHEMATIC DIAGRAM OF TRANSISTOR TRIGGER DELAY FOR TI-440

PARTS LIST

Item	Description	Number Required
1	Transistor Type GE 2N78	3
2	Transistor Type RCA 2N269	2
3	Germanium Diode IN127	2
4	Resistor 1K ohm 1/2 W	2
5	Resistor 100K ohm 1/2 W	1
6	Resistor 22K ohm 1/2W	2
7	Resistor 270 ohm 1/2 W	1
8	Resistor 390 ohm 1/2 W	1
9	Resistor 2 7K ohm 1/2 W	1
10	Resistor 3.3K ohm 1/2 W	1
11	Resistor 33K ohm 1/2 W	1
12	Resistor 1 8K ohm 1/2 W	1
13	Resistor 5 6K ohm 1/2 W	2
14	Resistor 3 9K ohm 1/2 W	2
15	Resistor 47K ohm 1/2 W	1
16	Resistor 56K ohm 1/2 W	1
17	Resistor 20K ohm 10W	1
18	Resistor 150 ohm 1/2 W	1
19	Resistor Variable 100K ohm miniature	1
20	Capacitor 30MF 25V	1
21	Capacitor Disc 0 01 MF	2
22	Capacitor Paper Tubular 0 0036 MF	1
23	Capacitor Paper Tubular 8200 MMF	1
24	Capacitor Ceramic 10 MMF	1
25	Capacitor Disc 0 002 MF	1
26	Capacitor Paper Tubular 2200 MMF	1
27	Capacitor Paper Tubular 1200 MMF	1

Note Any capacitor which has a rating above 25 W. V. D. C has an adequate rating for any of those on this list