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A SYSTEM FOR AUTOMATIC ACCUMULATION OF RADIATION DATA

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INTRODUCTION

Accumulation of data, during the irradiation of semi-conductor devices in a steady radiation environment, can be a time-consuming process. When using a Cobalt 60 radiation source with an intensity of 2×10^6 rads/hour, it may take several hours or even days before the total dose received by the device is sufficient to cause failure.

The Dymec Data Acquisition System certainly facilitates the recording of the data, but it still requires an operator to initiate the data-taking cycles. His job would be to push a single button at prescribed intervals of time. This, however, is inefficient and would be impossible for continuous day and night operation, due to manpower limitations. The simple solution is to use a digital clock to start the data-taking cycle, and the Dymec 570A digital clock is made expressly for this purpose.

An additional requirement, however, is that several different measurements be made on a single device. This means that the device must be switched in and out of several different test circuits (one for dc beta, one for I_{CBO}, etc.), or at the very least, that the parameters of a single test be varied (measure I_e for several values of I_b, for example). This is something that the Dymec system, even with the digital clock, cannot do. The modifications and the additional equipment needed to meet this requirement constitute the subject of this report.

EQUIPMENT

The accumulation of data is achieved by the Dymec Data Acquisition System, with components as shown in Figure 1. Two supplementary pieces of equipment were added to achieve the automatic operation. These were the digital clock, Dymec model 570A, and the scanner, Dymec model 2901, (called the program scanner in this report). The model 2901 scanner is an old model and cannot be used in the present Dymec Data Acquisition System. In fact, it was of no use whatever, until it was modified and incorporated in the automatic system described in this report. The digital clock is also an older model and is incompatible with the latest model 562AR digital recorder. Thus, it is impossible to

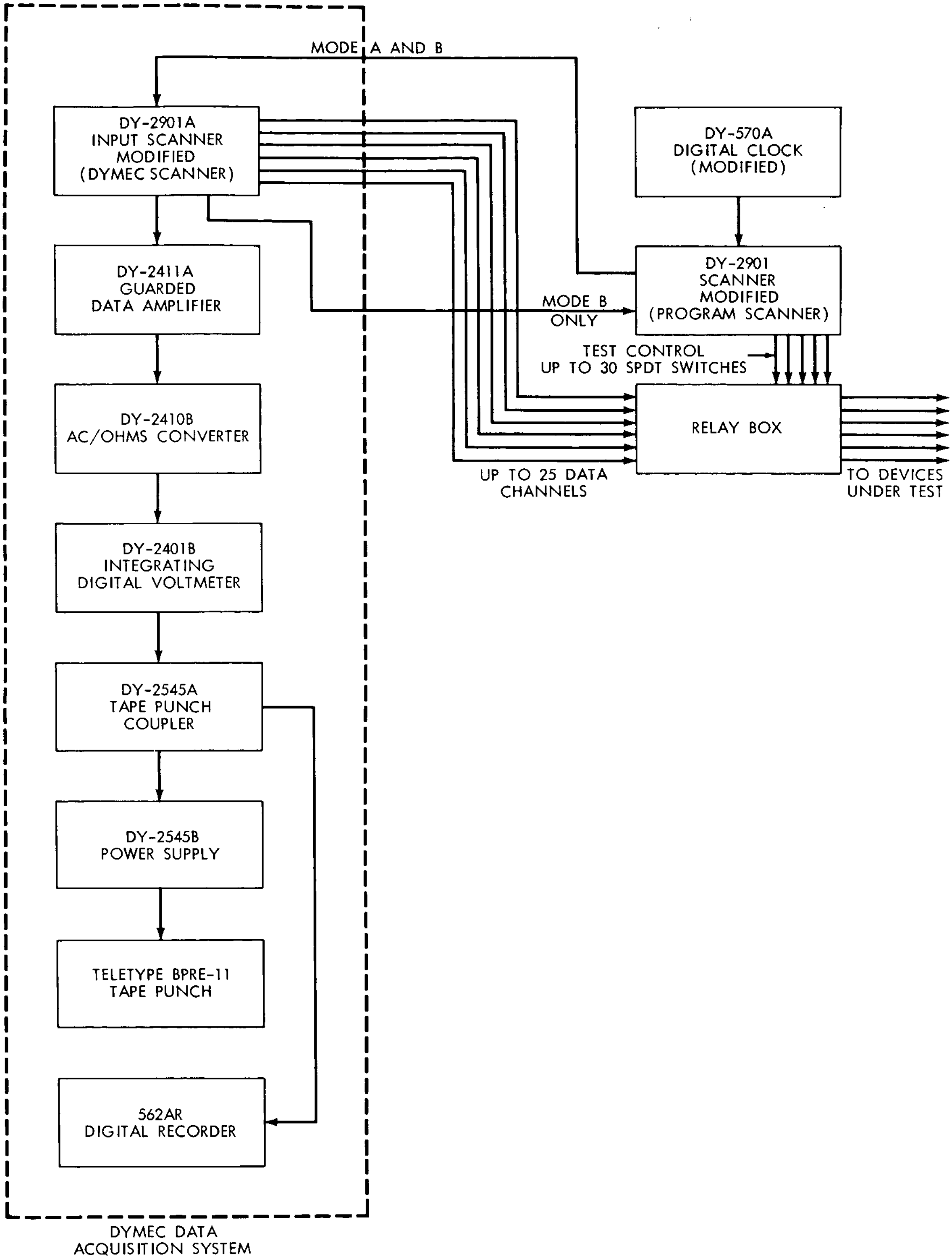

Figure 1. Block Diagram of Automatic System

obtain a print-out of elapsed time. But this is unimportant in the present application.

Still another piece of equipment, the relay box, was built to perform the task of changing the operating states of the devices under test on command from the program scanner.

DESCRIPTION OF OPERATION

There are two modes of operation. Mode A is used for test circuits, such as flip-flops, gates, or other devices having only two stable states. Mode B is used for components, such as diodes, transistors, silicon-controlled rectifiers, solar cells, etc., when more than two measurements on a single device are to be made.

The operation of the system in these two modes is as follows:

Mode A

The measurement cycle is initiated by a clock pulse. This causes the program scanner to step. Only two channels are selected on this scanner, say Channel 1 and Channel 15. The patch boards in this scanner and on the front of the relay box are programmed so that all devices under test are in one state in Channel 1 and in the other state in Channel 15. The state of the devices is switched automatically by relays when the scanner steps. Home position is bypassed so that the scanner will step from Channel 15 directly to Channel 1 without an intermediate stop. Whenever the program scanner steps, it signals the Dymec scanner to start a single scan. The Dymec System then measures and records the data on each device under test. When it reaches home, the cycle is complete and a new clock pulse is required to change the state of the devices and record the data again.

Mode B

The clock again starts the cycle but the program scanner starts in home position and home position is not bypassed. When this scanner steps to Channel 1, the operating conditions of the devices are selected and the Dymec System starts taking data as in Mode A. But, now, when the Dymec scanner reaches home, it signals the program scanner to step to the next channel. The operating conditions on the devices are changed and the Dymec scanner is signaled to begin a new scan. And so it continues, each scanner triggering the other until the program scanner reaches home, whence all activity ceases. Thus the program scanner has sequentially selected several operating conditions and the Dymec System has read them all out, in turn.

DETAILS OF MODIFICATIONS

1. Externally stepping the program scanner using the clock pulse—The program scanner is caused to step from one channel to the next by closing a contact between pins j and k of connector J104. This contact closure is provided by the digital clock at predetermined intervals of time. It is found at pins 35 and 36 in connector J602.

2. Bypassing home in the program scanner—Shorting positions 2 and 5 (external and continuous) on switch S202A will cause the program scanner to skip home. The short is made through a toggle switch on the front panel.

3. Externally starting the single scan in the Dymec scanner using the program scanner—If the front panel push button "single scan" is depressed, a contact closure between pins A and E of connector J103 will initiate the single scan. The relay K2 in the program scanner is activated every step. The unused half (Section B) of this relay is used to activate relay #2 which provides the contact closure.

   However, we do not want the single scan on the Dymec scanner to start, when the program scanner is stepping from Channel 25 to home. To achieve this, we used the circuit shown in Figure 2. When Channel 25 is reached, contacts on relay #1 open. As a result, relay K2 is rendered ineffective and no single-scan signal reaches the Dymec scanner. This requires that Channel 25 be one of the programmed channels in the program scanner when operating in Mode B.

4. Causing the program scanner to step when the Dymec scanner reaches home—To accomplish this, it was necessary to use the circuit in Figure 3. When the stepping switch in the Dymec scanner is in some position other than home, the capacitor is charging up. When the stepping switch reaches home, Relay #3 is activated and the capacitor is discharged through Relay #4. The normally open contacts close briefly to step the program scanner.

5. Relay Box—Connector J101 on the program scanner contains contact closures which are used to drive fifteen DPDT relays. These relays control the operating conditions of the devices under test. Any one or

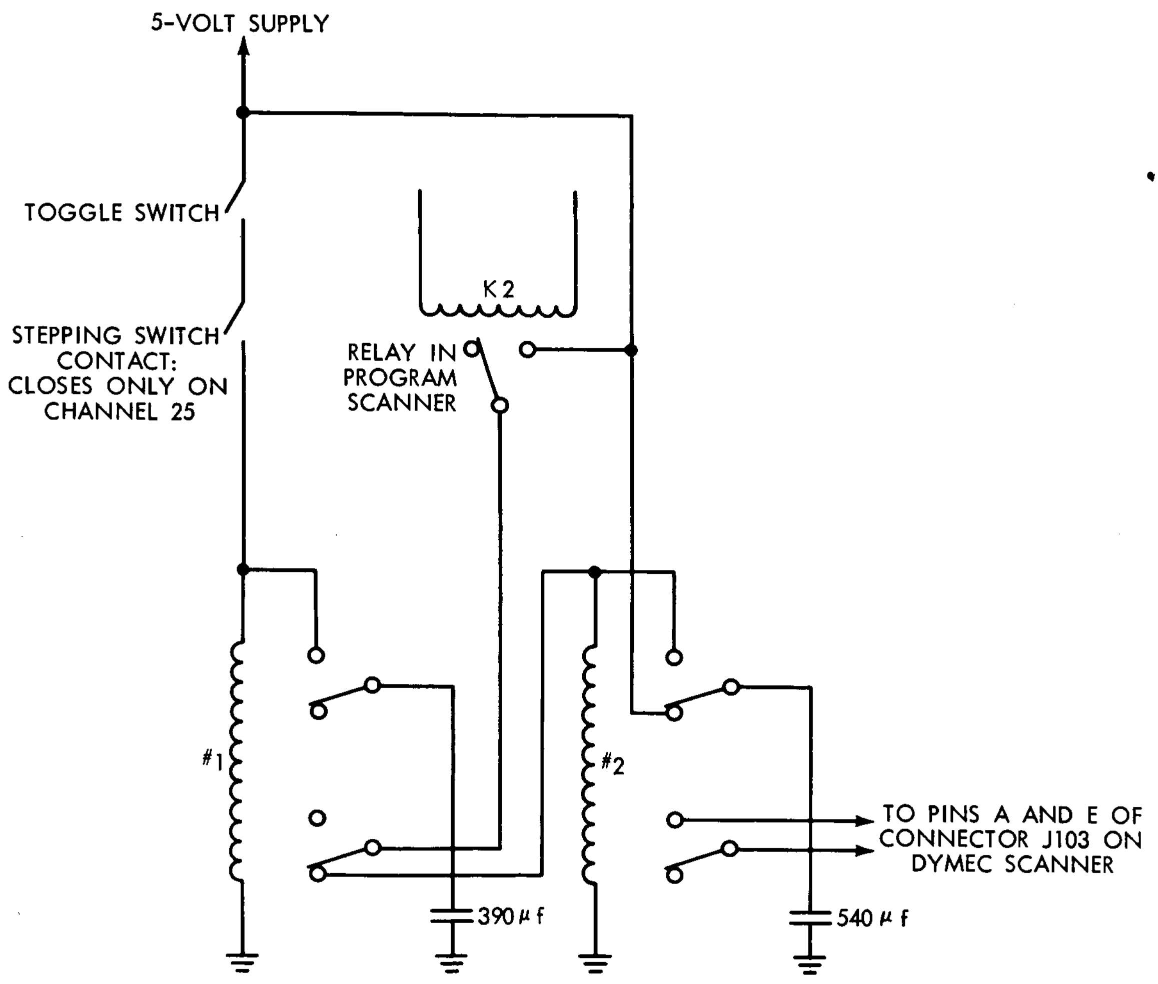

Figure 2. Modification of Program Scanner

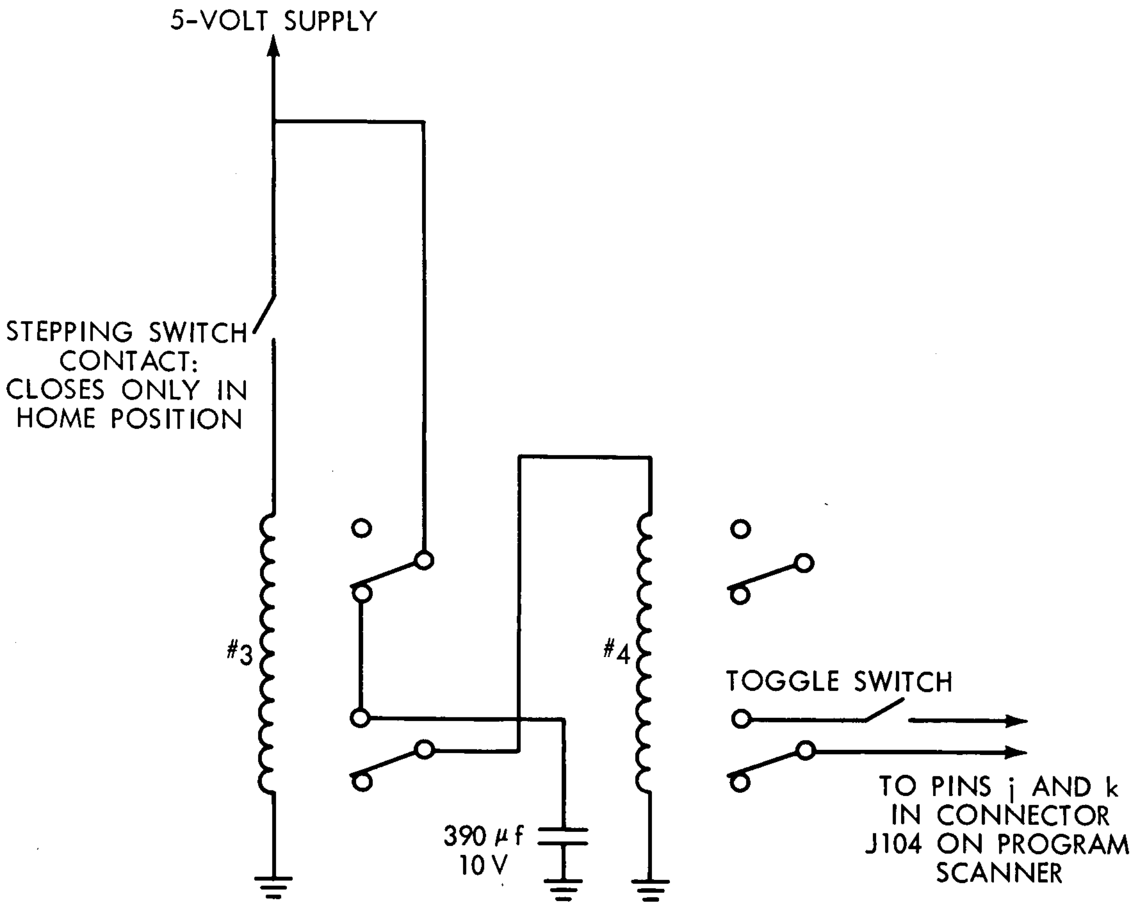

Figure 3. Modification of Dymec Scanner

all of them can be activated when the program scanner steps to any channel by inserting diode pins into the proper places in the program board. The contacts to the relay-activated switches are brought to the front panel of the relay box and color coded: Yellow - center tap; green - normally closed position; red - normally open. Also on the front panel are connections to the devices under test, and to the 25 channels of the Dymec scanner. The former are yellow and the latter red (high) and green (low). Power to drive the coils of the 15 relays is provided by a 5-amp power supply at 5 volts, which also plugs into the front panel of the relay box. This power supply is used to power the relays in the scanner modifications as well. Having all these connections on the front panel of the relay box results in versatility and ease in patching together test circuits.