DUAL-PURPOSE RELAY TIMER¹

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In the programming of operant conditioning schedules there are often situations in which an interval of 6 sec or less must be timed. Examples are: (1) duration of stimulus presentation such as a light or feeder device, and (2) situations in which reinforcement is contingent on duration of response. These examples fit into two categories: those in which the duration of a stimulus event is to be controlled and those in which the response (input) is to be measured.

The authors have developed a device which operates in two modes, input and output. In the input mode, the device times the duration over which the input terminal is grounded; if it meets the duration criteria set into the device, the output contacts are transferred for a standard interval of about 30 msec. In the output mode, if the input terminal is grounded for a standard interval, the output contacts transfer for the interval for which the device is set. The interval is adjustable from .075 to 6 sec, and two independent circuits may be controlled.

As shown in the figure, Relay 2, the two strings of resistors, S_1 , S_3 , and C_1 comprise an R-C circuit in which C_1 charges through the coil of Relay 2 and a shunt resistance paralleled with Relay 2's coil. The shunt resistance is determined by the settings of S_3 (interval) and S_1 (range). The time period for Relay 2 is equal to $.0024 \left(\frac{2500 R}{R + 2500} \right)$ at 28 v. R is the value of the shunt resistance in ohms.

In the output mode, S_2 is set as shown. If the input terminal is connected to ground (the negative side of the 28-v line) for at least 30 msec, Relay 1 transfers and C_1 begins to charge, transferring Relay 2 for the time

period determined by S_1 and S_3 . Relay 1 is held and Relay 3 is transferred through Relay 2's normally open contact. Relay 3 carries the output contacts. Thus, if the input is grounded for at least 30 msec, the output contacts transfer for the desired interval.

With S_2 set to the input mode Relay 1 is not held transferred by Relay 2 but must be held by the ground at the input terminal.

Fig. 1

Parts List

- $R_{1,2}$ —68 ohms
- R_3 —110 ohms
- R_4 —75 ohms
- R_5 —36 ohms
- $R_{6,7}$ —18 ohms
- R_8 —33 ohms
- R_9 —3,300 ohms
- R_{10} —750 ohms
- R_{11} —270 ohms
- R_{12} —240 ohms
- R_{13} —390 ohms
- R_{Y1} —SPDT relay, 24 vdc 300 ohm coil
- R_{Y2} —SPDT relay, 2500 ohm coil, 5 ma. operating current
- R_{Y3} —DPDT relay, 24 vdc 300 ohm coil
- S_1 —SPDT switch, toggle—range
- S_2 —DPDT switch, toggle—mode
- S_3 —DP6T switch, rotary—duration
- C_1 —1,500 mfd., 50 volt capacitor
- C_2 —50 mfd., 50 volt capacitor
- $D_{1,2}$ —250 ma. silicon diode
- $D_{3,4}$ —contact protector, 23 to 44 volts, 250 ma.
- Miscellaneous hardware: knobs, nuway studs, bakelite mounting panels, etc.

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Also, Relay 3 does not transfer with Relay 2 but instead is transferred for about 30 msec by C_2 if Relay 2 times out while Relay 1 is still transferred. Thus, in the input mode, if the input is held grounded for at least as long as the desired interval, the output contacts transfer for 30 msec.

The values of the resistors in the shunt were chosen so that S_3 selects intervals of 1, 1.5, 2, 3, 4.5, and 6. S_1 selects multipliers of .1 or 1.

The cost of the parts for the device is about \$25.00. It can be built in 2 to 3 hr. The unit

is compatible with standard 28 vdc equipment and can be mounted on power rods spaced $6\frac{1}{2}$ in. apart.

During a set of 300 trials when timing 6-sec intervals, the device had a maximum variability in its timed period of $\pm .07$ sec in either mode. When timing shorter intervals the variability was less.

It is felt that this device has a great deal of utility for the programming of operant conditioning schedules, especially for laboratories with low budget programs.