TECHNICAL NOTE

*A MULTIPURPOSE SWITCHING DEVICE WITH
INDEPENDENTLY TIMED N.O. AND N.C. STATES*

Figure 1 is a schematic of an inexpensive (under \$45) switching device that was developed to allow the duration of the "on" and the "off" periods to be varied independently of each other. This device also can control two lights so that the "on" state of one light coincides with the "off" state of the second light, and allows the operator to vary, independently, the duration of each.

Two unijunction transistor circuits are employed. When switch S_1 is closed, current flows through timing resistors R_1 and R_2 to charge capacitor C_1 . When the peak-point voltage is reached (the time required is a function of resistance R_1 and R_2) the unijunction T_1 triggers and C_1 discharges through the 3PDT relay coil, causing it to be activated. The holding circuit maintains the activated state after the pulse from the unijunction transistor. The activation of the 3PDT relay causes the normally closed (N.C.) circuit to be broken at the stimulus-control contacts and the normally open (N.O.) circuit to be made. The activation also causes a completion of the circuit involving timing resistors R_3 and R_4 so that C_2 charges. When C_2 reaches peak-point voltage, T_2 triggers causing the DPDT relay to be activated momentarily, thereby breaking the circuit that is holding the 3PDT relay in an activated state. With the holding circuit open, the 3PDT relay returns

to the normal state, breaking the N.O. circuit and making the N.C. circuit at the stimulus-control contacts. The return of the 3PDT relay to its normal state also completes the circuit that again starts to charge C_1 to begin the next cycle. Thus, the timing circuit involving R_1 and R_2 determines the duration of the normal state of the 3PDT relay and the timing circuit involving R_3 and R_4 determines the duration of the activated state of the 3PDT relay. Switch S_2 , when open, causes the stimulus-control contacts to function in an ABA mode; when it is closed the device functions in a BBA mode.

The durations of these two states for the values shown in the schematic range from about 50 msec to 2.5 sec. (The actual durations will vary slightly depending upon the exact values of the resistors and the capacitors in the timing portions of the circuit.) Larger fixed resistors (R_2 and R_4) would lengthen the shortest duration possible. Larger variable resistors (R_1 and R_3) would increase the range of the durations, but some fineness of adjustment would be lost. Precision multi-turn potentiometers would increase reset reliability if used instead of the control potentiometers (R_1 and R_3).

The size of the capacitors (C_1 and C_2) is critical for two reasons. First, the time required to reach peak-point voltage is a function of the capacitance, as well

C_1, C_2	100 MFD, 50 v, electrolytic capacitor
D_1, D_2	1N3253 diode
R_1, R_3	20 K ohm potentiometer
R_2, R_4	1000 ohm, 0.5 watt, resistor
R_5, R_7	330 ohm, 0.5 watt, resistor
R_6	330 ohm, 5 watt, resistor
S_1	DPST switch
S_2	SPST switch
T_1, T_2	2N491A unijunction transistor
DPDT	DPDT relay, 12 VDC, 120-150 ohm coil
3PDT	3PDT relay, 12 VDC, 120-150 ohm coil

as the resistance, of the timing circuit. For this reason, a more stable tantalum capacitor may be substituted for the electrolytic, if accuracy of the timing setting is an important consideration. Second, the capacitor must furnish the current to operate the relays. The values of C_1 and C_2 (100 MFD) constitute about the minimal requirement for consistent operation of the relays specified in the schematic. It would therefore be possible to increase the duration by increasing capacitance,

but it is not feasible to reduce the duration by decreasing capacitance.

The apparatus has been in use for over 1500 hr without malfunction. Repeat reliability of successive timing intervals has been determined to be $\pm 1\%$ after the capacitors C_1 and C_2 have been in operation for at least 50 hr.

CORD B. SENGSTAKE
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