An inexpensive 28-V timer circuit using solid state and relay devices

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An easily constructed 28-V dc timer circuit is described. The circuit is as precise, reliable, and versatile as some commercially available units, but is much less expensive to construct.

Researchers who use 28-V relay systems for programming may find it difficult to match the precision and reliability offered by commercial solid state timer modules. The electronically "noisy" environment created by relays often interferes with the reliability of solid state modules, especially those with integrated circuits. Although serviceable solid state timer modules are commercially available, the additional circuitry necessary to make them reliable when used with relay equipment often makes these units quite expensive.

A solid state device is now available that allows the experimenter to construct a 28-V timer module which is as precise and reliable as those commercially available. Figure 1 illustrates one such timer circuit. The unit can be constructed easily and inexpensively from relays, solid state components, and a hybrid device known as an Icsotimer.¹ The Icsotimer is a 24-V time-delay relay driver. This unit is designed especially for use with relay operations and therefore avoids reliability problems encountered in integrated circuits.

A ground pulse at operate (OP) biases Triac T_1 , switching ground through the contacts of relays K_1 and K_2 . Diode D_5 protects T_1 from inadvertent positive pulses at OP. The Triac remains biased, regardless of other events at OP, until the circuit is broken by K_1 or K_2 . The biasing of T_1 also supplies ground for relays K_3 and K_4 . K_3 operates immediately for as long as the Triac is biased, allowing its external contacts to be used for timing functions. Current through the coil of K_4 operates the Icsotimer, M_1 , which is a time-delay relay driver. At the end of the timing operation of M_1 , relay K_4 is activated. A timed-out pulse is provided by the external contacts of K_4 . Spark suppression for relays K_1 , K_2 , K_3 , and K_4 is provided by diodes D_1 , D_2 , D_3 , and by M_1 , respectively.

Reset functions are provided by the operation of K_1 or K_2 , which returns the Triac to its unbiased state.

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Figure 1. Timer circuit.

K_1 operates after capacitor C_1 is charged by the switching of ground through the internal contacts of K_4 . C_1 and resistor R_3 provide sufficient duration for the timed-out operation of K_4 . The values given for R_3 and C_1 provide a timed-out operation of approximately 70 msec, but these can be modified to suit the user's needs. External operation of K_2 allows a reset or abort function, unbiasing the Triac and terminating the timing operation of K_3 without providing a timed-out pulse at K_4 .

The duration of the timing function provided by this circuit is determined by the specific model of the Icsotimer and the resistance at R_2 . Four models of the Icsotimer currently available provide different time ranges: .1-1 sec, .5-5 sec, 5-50 sec, and 30-300 sec. Within each range the minimum duration occurs with R_2 to 2 megohms, but can be doubled by increasing the value of R_2 to 4 megohms, the maximum useable re-

Table 1
List of Components for Timer Circuit

D_1, D_2, D_3, D_4, D_5	1N4001 Diodes
C_1	250- μ F 50-V Electrolytic Capacitor
R_1	680- Ω $\frac{1}{2}$ -W 10% Resistor
R_2	2-Megohm 2-W Potentiometer
R_3	220- Ω $\frac{1}{2}$ -W 10% Resistor
T_1	50-V 6-A Triac
M_1	KH 24-V Icsotimer
K_1, K_2	28-V SPDT Relays
K_3, K_4	28-V DPDT Relays

sistance specified by the manufacturer. The Icsotimer allows for precision timing for a variety of ranges, with a repeat accuracy within 2%.

The timer modules can be constructed simply and inexpensively. All components can be mounted on a single Plexiglas panel measuring 15.3 x 17.8 cm. The units presently in service have the Icsotimers mounted

on spring binding posts. This allows different models of the Icsotimer to be rapidly interchanged for greater versatility. The Icsotimer cost \$8 in November 1976. The total cost for all electrical components, including the Icsotimer, is approximately \$35. Components are listed in Table 1.

Ten of these units have been constructed and used in our laboratory for up to 1 year. With the exception of one Icsotimer failure, we have been totally satisfied with their service.

NOTE

1. Specifications for the Icsotimer can be obtained by writing the manufacturer, Instrumentation & Control Systems Inc., 129 Laura Drive, Addison, Illinois 60101.

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