

UNIVERSAL TIME SWITCH

by R. Lucassen

THIS circuit meets the requirement for a simple, low-cost timer with a timing range of a less than a second to several tens of hours, and a thyristor-based mains interface capable of controlling inductive loads.

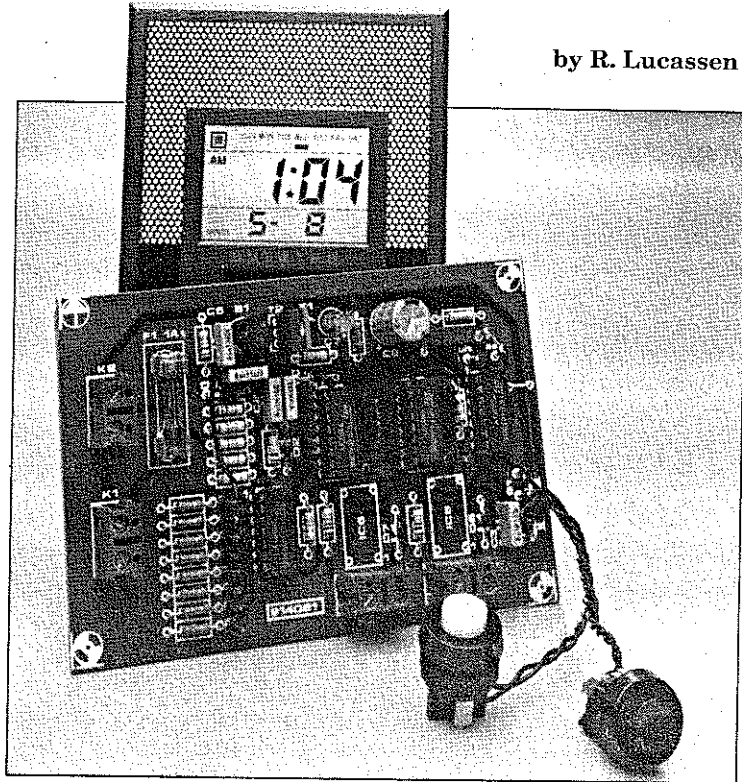
The circuit consists basically of a timer section and a switching section. The timer derives its accuracy from the mains frequency: 50 Hz or 60 Hz. Components R4, R3, R2, C1 D1 and D2 convert the mains voltage into a clock signal for binary ripple counter IC1, a 4040. Counters IC1, IC3, and an 8-input AND gate, IC4, form a programmable divider. When the time set with the jumper wire(s) at the outputs of IC2 and IC3 has elapsed, the output of IC4 goes low and causes bistable IC2b-IC2c to toggle. As a result, the gate drive of thyristor Th1 is removed, and the load connected to K2 is switched off. To prevent mains pollution and switching noises, the load is switched during the zero crossing of the mains voltage. The timer can also be used to switch on a load after the preprogrammed time <197> this only requires wire jumper 'Y' to be fitted instead of 'Z'.

The time is set by fitting a maximum of eight wires between the 8-input AND gate and the counter outputs. The actual time is the sum of all selected times listed in the table.

The 12-V supply voltage for the circuit is obtained from the mains with the aid of a single-phase rectifier, D3. The supply voltage is stabilized and smoothed by zener diode D5 and reservoir capacitor C6.

The two series resistors in the rectifier, R16 and R17, must not be replaced by a single 100-k Ω resistor. Remember, the total voltage drop across R16 and R17 is of the order of 220 V (at a mains voltage of 240 V), which is too much for a single resistor rated at 0.5 W. The same applies to resistors R3 and R4.

The timer is actuated by pressing push-button S2. Note that actuating the timer means that the load is switched on or off, depending on whether jumper Y or Z is fitted. During the timing cycle, the circuit can be reset by pressing S2 again. This starts a full timing cycle, irrespective of when the switch was pressed. The timing cycle can be stopped by pressing S1. Provision is made for electronic control of the start and stop functions. This is achieved with the aid of two optocouplers, IC5 and IC6. The electronic control inputs, K3 and K4, are electrically isolated from the timer, and can be driven with control voltages of 5 V. The construction of the timer is straightforward. A minimum of wiring is required since all parts are contained on a single printed-circuit board. The start and stop switched must be rated at 250 V because they are at mains potential. The circuit must be fitted into an ABS enclosure with non-metallic screws. Take care to provide adequate strain reliefs and insulation of the mains input and output cables.



WARNING. Since the circuit carries dangerous voltages at a number of points, never work on the circuit when the mains is connected to it. Make sure that no part of the circuit can be touched when it is being set, adjusted or used.

