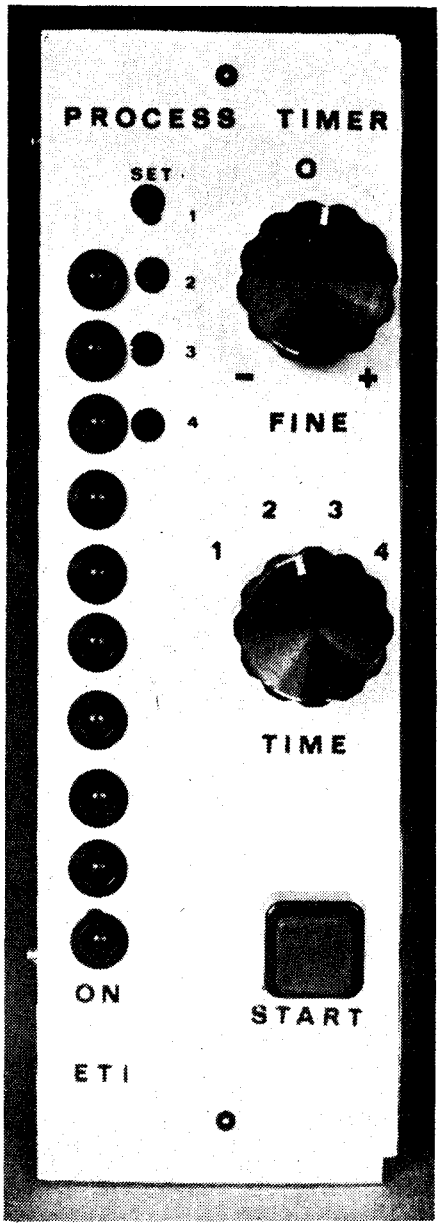
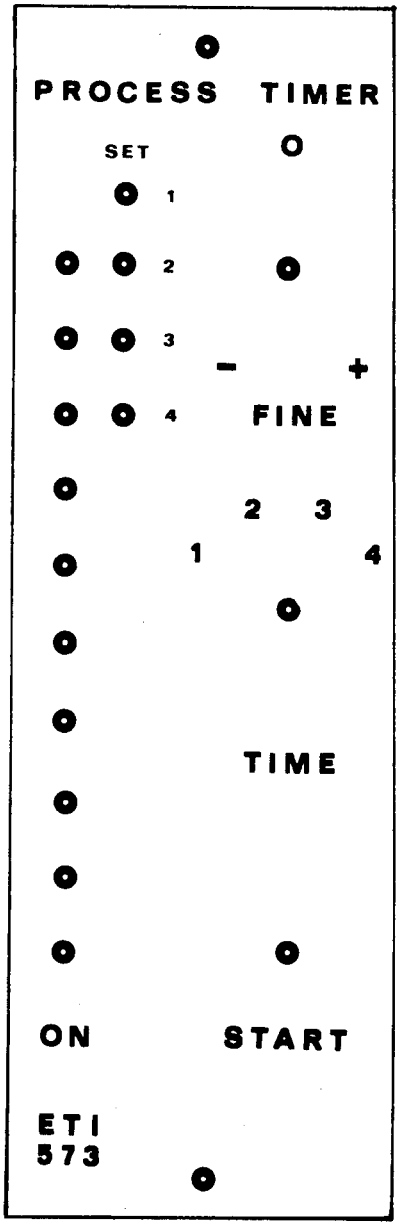
UNIVERSAL PROCESS TIMER

This controller has myriad applications in electronic and photographic work. It features an LED display which 'counts down' and is easily visible in darkroom or daylight.





VARIOUS PROCESSES in fabricating electronic projects require timing a chemical reaction or process – developing photoresist in making printed circuit boards being a prime example.

The Technique

The easiest way of producing a time delay is by using a 555 timer IC, but a glance at the data sheets shows that it should not be used for periods in excess of 100 seconds. By using the 555 as an oscillator and feeding its output into a 4017 counter/decoder IC the maximum timing period can be increased ten fold. The unused decoded outputs can then be connected to a column of LEDs which will give an indication of elapsed time.

Each pulse from a 555 clocks the 4017, moving a high level along its ten decoder outputs, lighting each of the LEDs in turn. When the high level reaches the last output it is used to operate the relay and thus the time delay has been multiplied by ten.

A permanently-lit LED has been included at the bottom of the row to show when the unit is on. This also gives a better indication of elapsed time in a darkroom, as the LEDs can be seen to step towards a reference light.

Four time ranges have been provided with a trim pot on each one for easy adjustment. The table gives the values for each trim pot and C1, for a variety of times. The minimum time is limited by the time taken for the relay to operate, maximum time by the limitation of the 555. In practice, times from 100 mS to twenty minutes

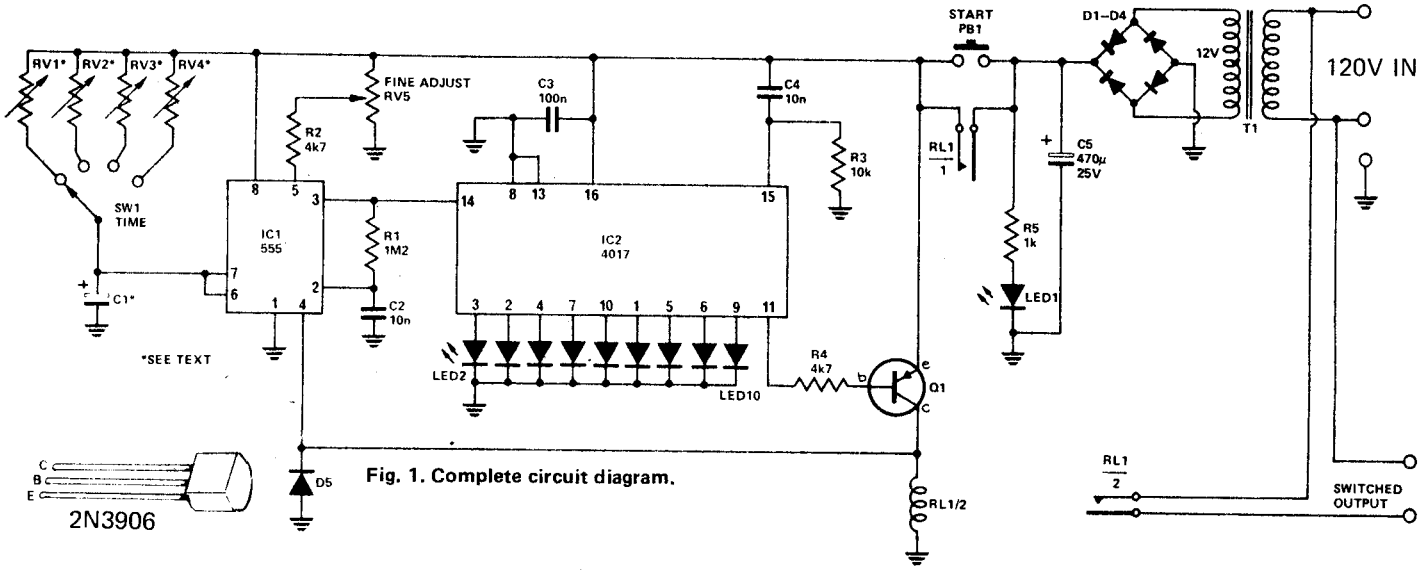
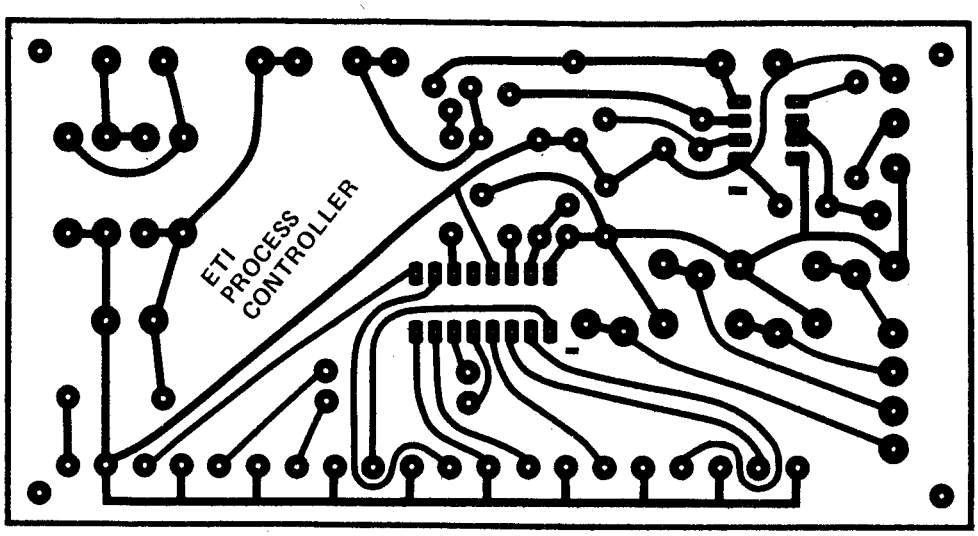


Fig. 1. Complete circuit diagram.



The PCB pattern shown full size.

PARTS LIST

Resistors all ¼W, 5%
R1 . . . . . 1M2
R2 . . . . . 4k7
R3 . . . . . 10k
R4 . . . . . 4k7
R5 . . . . . 1k

Potentiometers
RV1–RV4. . . See text
RV5 . . . . . 10k lin pot

Capacitors
C1. . . . . See text
C2. . . . . 10n polyester
C3. . . . . 100n polyester
C4. . . . . 10n polyester
C5. . . . . 470µ 25V electrolytic

Semiconductors
D1–D4. . . . IN4004 or sim Power Diode
D5 . . . . . IN914 or sim
Q1 . . . . . 2N3906
IC1 555
IC2 4017
LED1–
LED10 . . . . TIL220R or sim LED

Miscellaneous
SW1. . . . . One pole, four pos. switch
PB1. . . . . Momentary Push Button
T1. . . . . 12V, one amp transformer
RL1. . . . . 12V relay with two changeover contacts, PCB, knobs, suitable box or bracket.

can be achieved. For very short times the time elapsed indication will not be much use and the LEDs can be left off the board.

Fine adjustment of the timing is achieved by adjusting the threshold voltage on pin 5 of the 555. When the voltage on pin 5 reaches a set value, the output (pin 3) of the 555 goes 'low' (i.e: the 555 triggers). This voltage is normally set at two-thirds the value of the supply rail, fixing the time during the charging cycle of C1 when the 555 triggers.

If the threshold voltage is increased, the time taken for C1 to charge to the required value increases, and the frequency of oscillation decreases. Thus, the total timing period is increased.

What device you want to control with the timer will determine the type of relay you use. This unit is capable of driving quite large relays, however, we used a commonly available type having contacts rated at 10A.

Construction

First, you will have to determine from the table the correct values of RV1-RV4 and C1 to provide the times you want for your application.

Next, mount all the components taking care to correctly orientate the semiconductors. The LEDs are best mounted by inserting them into their holes and bending them over flush with the edge of the PCB. The photo shows the way we mounted the LEDs.

The completed unit can be mounted in a variety of ways to suit individual applications. Either in a box, together with its relay and a mains female output socket for the switched output, or on a panel with a

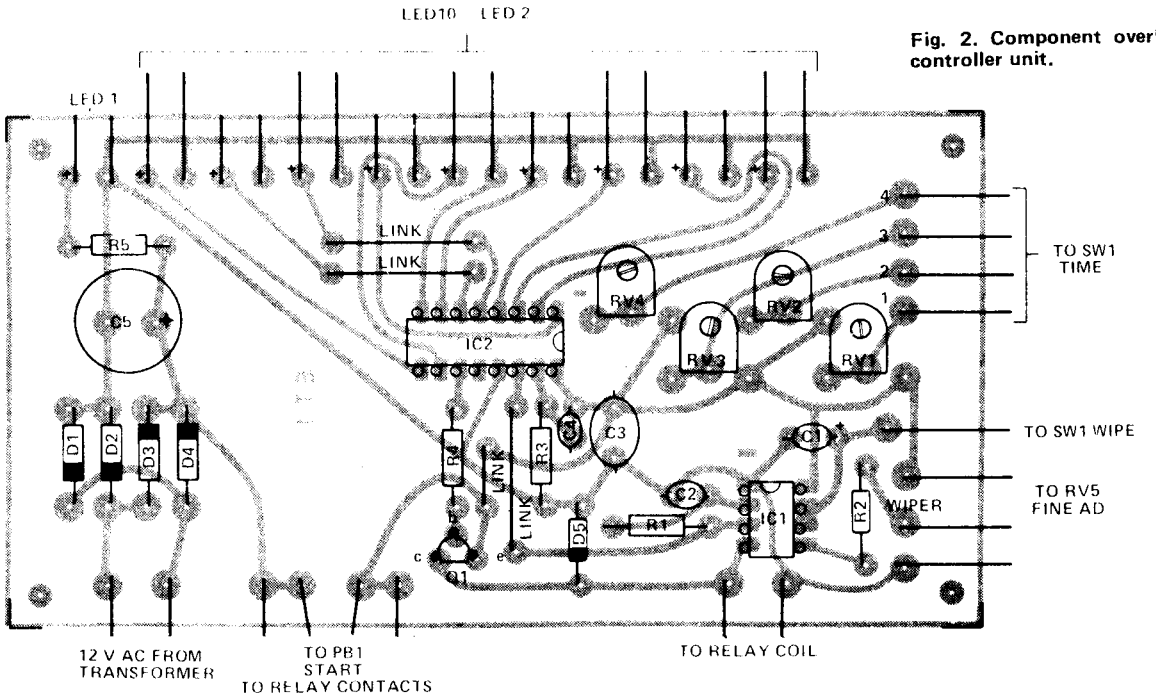


Fig. 2. Component overlay for the process controller unit.

Maximum time delay	1 sec	10 sec	100 sec	1000 sec
value of C1	1 μF	1 μF	10 μF	100 μF
value of RV (1 - 4)	200 k	2 M	2 M	2 M

Table of values for C1 and RV1 - RV4 required for differing time delays

PROBLEMS? NEED PCBs? Before you write to us, please refer to 'Component Notations' and 'PCB Suppliers' in the Table Of Contents. If you still have problems, please address your letters to 'ETI Query', care of this magazine. A stamped, self addressed envelope will ensure fastest reply. Sorry, we cannot answer queries by telephone.

HOW IT WORKS

The timer consists of a 555 timer IC used as an oscillator driving a 4017 counter/decoder IC, the decoded outputs being used to drive a row of LEDs and switch a relay.

The timing period is set by the frequency of oscillation of IC1. This is dependent on the time constant of RV1-RV4 and C1. As either of these components are increased in value the time constant will increase and the frequency of oscillation decrease. Fine frequency adjustment is provided by RV5 which adjusts the threshold voltage on pin 5 of the 555. This voltage is normally set at two thirds of the supply voltage, but here it is adjusted varying the required voltage across C1 to the 555.

Output from the 555 is fed to the clock input of the 4017. After each pulse a different decoded output of the 4017 goes high, lighting each LED in turn. After the tenth clock pulse the output on pin 11 of the 4017 goes high. We shall come to what that does shortly.

When power is first applied, the relay contacts RL1/1 are open and the bottom LED (LED 1) is lit. When the 'start' button is pressed the 4017 is reset to zero by a positive pulse applied to pin 15. This pulse is provided from R3 and C4. Pin 11 goes low, turning on the PNP transistor Q1, and the relay operates. The now closed relay contacts (RL1/1) short out the start button and sustain the power after the start button has been released. The transistor also drives the reset line of the 555 (pin 4) which commences to oscillate. This ensures accurate timing of the first cycle.

On the tenth pulse from the 55 pin 11 of the 4017 goes high, turning off Q1, stopping the oscillator, and the relay is de-energised. The contacts RL1/1 open removing the supply to the timer returning it to its original condition, ready for the next sequence.

During the timing period, the second set of contacts RL1/2 close and can be used to switch up to 5A using the relay specified.

remote transformer and relay.

To mount the unit against a front panel, drill a row of ten holes for the LEDs and four holes to line up with the trim pots for screwdriver adjustment of the timing. The start button, timing switch and fine adjustment pot can be mounted anywhere convenient. The board should be mounted against the panel so the LEDs protrude through the holes.

Setting Up

Having assembled the unit, all that remains is to calibrate the ranges. This is easily done with the aid of the second hand of a watch. For shorter times, say under five seconds an oscilloscope is best.

Monitor the positive supply after the relay contacts RL1/1 and measure the time the contacts operate. For other purposes it may be best to set the ranges by trial and error, such as when the it is being used for a PCB development timer. In either case, the fine adjustment control should be set in its mid position when calibrating.●