

Leave VR1 in this position. Now, when a noise is made beside the microphone, the bistable should set. Further slight adjustment of VR1 can then be made to find the most sensitive setting.

At this stage the reader may find it worthwhile to remove VR1 from the circuit without altering its setting, and use a testmeter to measure its resistance. When the circuit was under trial on the Test-Bed it was found that the effective resistance of VR1 at this stage was a little over 60 kilohms; VR1 was then replaced by a fixed carbon resistor of 56 kilohms in series with a 10 kilohm preset. This arrangement made it easier to adjust the circuit for greatest sensitivity.

When adjusting is complete, the connections to the l.e.d.s are removed and the oscillator is assembled and connected to the bistable output at S34.

Before leaving the subject of interfaces we should mention the simplest interface of all—a pair of metal contacts forcibly brought together or parted.

For burglar alarm systems a number of pairs of contacts can be positioned on windows and doors, so as to be in contact when the window or door is shut, but parted when it is opened. Parting the contacts, one of

which is connected to ground and the other to the a.f. oscillator, causes the alarm to sound.

Pressure mats are available for use beneath carpets and make contact when they are trodden on. These too can be used as interfaces to alarm circuits.

TTL VERSATILITY

This part of the series has been almost entirely concerned with alarm circuits, but many of the units described have applications in other fields. The sound-triggered interface can be used with the digital dice (April 1979) to make a novel voice-operated dice that displays a random number when a play shouts "Stop".

The temperature-sensitive interface can be connected to a timing circuit so that we can measure for how many hours of the day or night the temperature of a room (or greenhouse) exceeds a given level. We can build a circuit that switches on an electric fan when the room becomes too hot. With a little more ingenuity we can cause an electric train to stop, or start, or reverse in sequence each time a whistle is blown. By blowing the appropriate number of blasts on the whistle the motion of the train can be remotely and realistically controlled. Such a controller would need

only the sound-operated interface, a number of flip-flops, a few power switches and some relays.

Most of these have all been described in previous articles in this series, and all that needs to be done is to work out the logical way of connecting them together so as to perform the required function.

There seems to be virtually no limit to the number of ways of connecting together the relatively few basic units that we have examined so far. Whatever you want to do electronically, the great versatility of TTL makes it highly likely that you will succeed in *doing it digitally*.

To be continued


ERRATUM

An error occurred in the Keyboard construction diagram Fig. 5.5. Four 470 ohm pull-down resistors and the connection to ground were omitted. These resistors should be inserted to span 125/A25, 126/B26, 127/C27, and 128/B28. Also a Soldercon pin, Veropin or flying lead needs to be connected to location 134.

It is important that this amendment be made as the Keyboard is used a lot in Parts 11 and 12.

DARKROOM TIMER

By A. R. Winstanley



THERE MUST be many instances when a simple visual indication of elapsed time could prove to be just as effective as the most sophisticated of electronic timepieces. The unit described here is a small portable device which illuminates a light emitting diode once per second.

The circuit itself is very simple and so phenomenal accuracies cannot be expected from it. It is possible however to obtain an accuracy of about $\pm 1/60$ th of a second.

The reader will no doubt find other uses, besides its intended use a timer in the darkroom. It should be possible to use the unit for both colour and black/white printing and enlarging, although one must be aware of its accuracy.

CIRCUIT DESCRIPTION

The circuit diagram appears in Fig. 1. The transistor arrangement illustrated will be familiar to many readers and is called an *astable multivibrator*.

Operation of this configuration is as follows.

When power is initially applied, one of the transistors must turn on before the other, this is due to inherent component tolerances. For simplicity, let us assume that TR1 will switch on first. The positive plate of C1 is therefore grounded, and this negative pulse is transmitted to TR2 base, which effectively biases TR2 off. With TR1 on and TR2 held off, C1 charges up via VR1 and R2 until the potential at

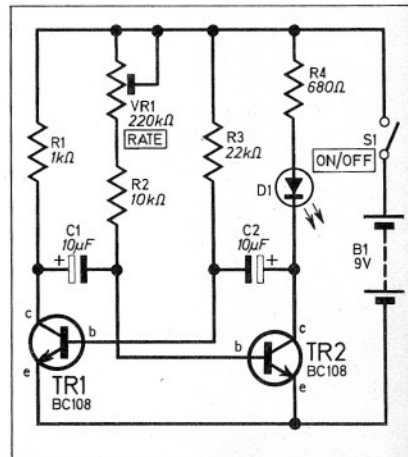


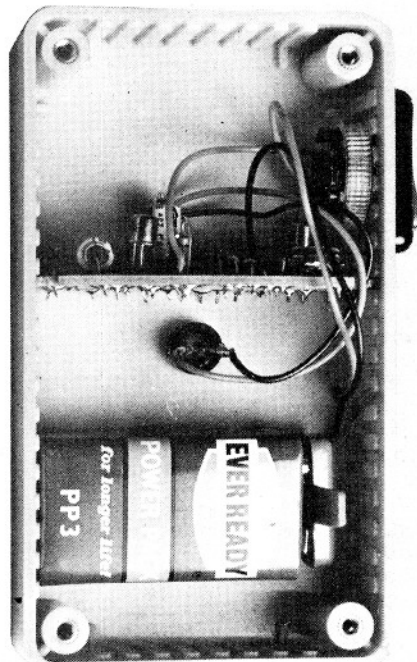
Fig. 1. Circuit diagram of the Darkroom Timer.

TR2 base equals some 600mV.

When this point is attained, TR2 is now able to switch on, as its base is now correctly biased. As TR2 switches on, D1 is able to illuminate, R4 serving to limit the current to a safe level; also, a negative pulse is transmitted via C2 and TR1 base and effectively switches TR1 off.

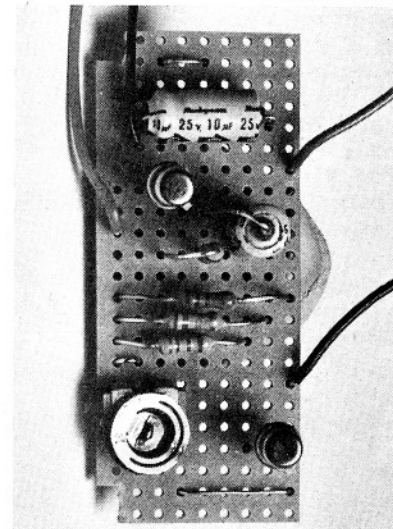
With TR2 on and TR1 off, C2 can charge through R3 until 600mV is present at TR1 base, this permitting TR1 to switch on again, and so causing TR2, via C1, to be forced off.

It can be seen that the whole circuit is oscillating, the charging cycles repeating themselves, and this will continue until the power supply is removed. By adjusting the timing components, VR1, R2, R3, C1 and C2 we can adjust the frequency of operation of the circuit, and in fact VR1 is included so that a near perfect one hertz frequency (one cycle per second) is achievable.



The completed prototype with base panel removed.

These dimensions permit the retention of the circuit by the p.c.b. guides moulded within the case. The plastic box used is a Bimbox type BIM2003/13 and it measures 112 x 62 x 31mm, although any similar size can be used.



The component layout on the stripboard.

Construction of the unit will be quite straightforward as seen from Fig. 2, and there should be no problems. Note that 1/4 watt resistors are used throughout; these can be quite heat sensitive (as are the transistors) so take care to use a heat-shunt during soldering. Take care to orientate the transistor leadouts correctly and similarly note the connections to the l.e.d.—the cathode is indicated by the "flat" on the case.

Drill the case to take the l.e.d. mounting clip and the switch. Letter

COMPONENTS

Resistors

- R1 1k Ω
- R2 10k Ω
- R3 22k Ω
- R4 680 Ω

All 1/4W carbon \pm 5%

See
**Shop
Talk**

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Potentiometer

- VR1 220k Ω miniature horizontal preset

Capacitors

- C1 10 μ F 10V elect.
- C2 10 μ F 10V elect.

Semiconductors

- TR1, 2 BC108 silicon *npn* (2 off)
- D1 TIL209 red light emitting diode

Miscellaneous

- B1 9V PP3 battery
- S1 s.p.s.t. "Hekla" rocker switch (Maplin)

Stripboard: 0.1 inch matrix 23 holes x 9 strips; plastic case: Bimbox type BIM2003/13 orange or similar 112 x 62 x 31mm; battery clip to suit B1; mounting clip for D1; lettering as required; connecting wire.

Approx cost Guidance only
£1.50 excluding case

CONSTRUCTION starts here

The circuit, with the exception of the l.e.d., is built on a piece of 0.1 inch stripboard measuring 9 strips by 23 holes.

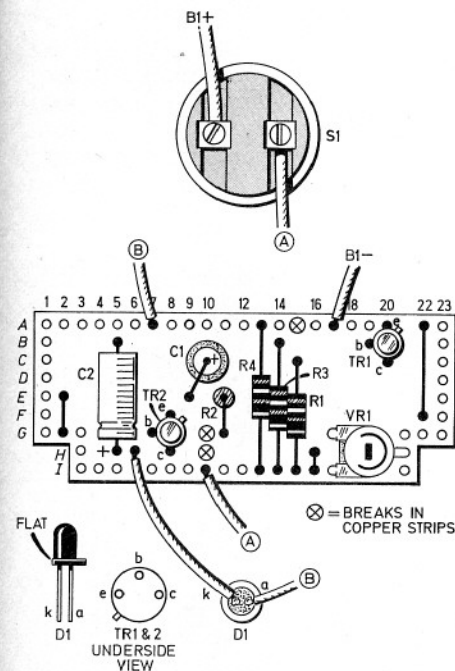


Fig. 2. Complete wiring details for the unit. Take particular care when soldering heat sensitive components, and observe polarity.

the case as required using proprietary rub-down lettering and then spray the case with a coat or two of clear aerosol lacquer to protect the lettering.

Check the wiring carefully, set VR1 to its midway position and then switch the unit on. The l.e.d. should be flashing at an arbitrary frequency. Unfortunately setting up is rather a trial and error affair, and consists of trimming VR1 until the l.e.d. is illuminating once per second at the desired accuracy.

One method of monitoring the accuracy is to count the number of flashes in 60 seconds, and divide this answer by 60 to obtain the interval between flashes.

