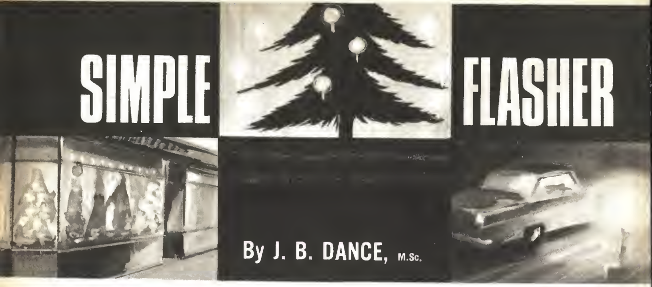

SIMPLE FLASHER

By J. B. DANCE, M.Sc.

IN THE June issue of PRACTICAL ELECTRONICS the introduction of a new integrated circuit, the 555, was discussed in detail from both the theoretical and practical point of view. Only one application as a timer suitable for photography or event control was considered as a constructional project.

Thus we now consider the application of this i.c. to the control of such items as the lights on the Christmas tree or in a window display so as to provide a flashing effect. At the instant the one set of lights is switched off, another set can be switched on if this is desired. The two sets are then illuminated alternately.

THE CIRCUIT

The type NE555V i.c. which has a dual-in-line encapsulation was used by the writer, but the NE555T in the circular TO-99 encapsulation is equally suitable. Both types have eight connecting leads and contain the equivalent of 23 transistors, two diodes and 16 resistors in a small package.

The 555 is used in the astable mode in this application. In the circuit shown in Fig. 1, the capacitor C1 alternately charges and discharges so that the potential across it varies between $V_{cc}/3$ and $2V_{cc}/3$. Each time the voltage across C1 falls to $V_{cc}/3$, the 555 is automatically re-triggered by means of the connection to the trigger pin 2; the capacitor then commences to charge again.

TIMING

The charging current flows through both R1 and R2. It can be shown that the time for charging from $V_{cc}/3$ to $2V_{cc}/3$ is $0{\cdot}693(R_1 + R_2)\,C_1$ seconds where R_1 and R_2 are expressed in ohms and C_1 is expressed in farads. During discharge the current from C1 flows through R2 only; thus discharging takes the shorter time $0{\cdot}693R_2C_1$. The frequency of oscillation is $1{\cdot}44/(R_1 + 2R_2)C_1$. The charging time cannot be made shorter than the discharging time.

If one uses the values for R1, R2 and C1 shown in the circuit, one can calculate that the charging time is 4·8 seconds and the discharging time 3·3 seconds. This should be suitable for the automatic switching of lights in a shop window or on a Christmas tree.

In practice the times will not be exactly equal to the calculated values since the values of the three components will differ somewhat from their marked values. In particular, electrolytic capacitors have very wide tolerances.

The component values can be altered to obtain the desired switching times. However, for applications of this type one does not need to adjust the values critically. One may require shorter times for use in a flashing toy; for example, C1 may be reduced to 2μF of 1μF. The value of the power supply voltage, V_{cc}, does not affect the switching times appreciably.

THE RELAY

The relay remains open whilst the capacitor is charging, but closes during the discharging time. A diode must be placed in parallel with the relay in order to suppress the transient back e.m.f.; the latter is generated across the inductive relay coil when the current ceases to flow through it. If the transient voltage is not suppressed with a diode, it could damage the integrated circuit.

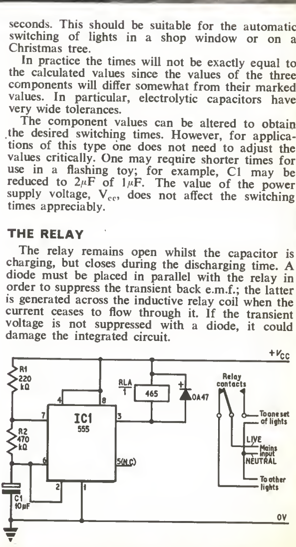

Fig. 1. Circuit diagram for the simple i.c. flasher

The writer used an economical microswitch relay type MS1B designed for printed circuit board mounting. It is readily available (through retailers) from Keyswitch Relays Ltd. The value of the power supply voltage, V_{cc}, used must match the recommended relay operating voltage to within about 20 per cent. If V_{cc} is between five and seven volts, an MS1B with a 6V, 50mA coil rating should be employed. Alternatively V_{cc} may be between 9·5 and 15·5V, in which case the MS1B employed should have a 12V, 26mA coil rating.

The MS1B relay has a single group of change-over contacts which can switch 250V at up to 5A in a.c. circuits. This maximum power of 1·25kW is more than is likely to be required in any shop window of moderate size.

Nevertheless, a larger relay can be used in this circuit if necessary provided that it does not require a current of over 200mA to operate it. Another type of microswitch relay, the Keyswitch Relay type MS2B, has two pairs of change-over contacts each of which can control a current of up to 2A in a 250V a.c. circuit. In d.c. circuits the current ratings of relay contacts are lower (0·2A at 250V and 0·25A at 100V for both the MS1B and MS2B).

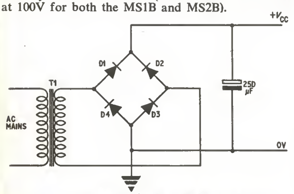

Fig. 2. Circuit diagram for a suitable power supply

POWER SUPPLY

The circuit of Fig. 1 can be operated from a small battery. Indeed, this is the most sensible source of power to use in a toy for children. The integrated circuit itself requires a current of about 3mA (maximum 6mA) when V_{cc} is 5V, but the current rises to about 10mA (maximum 15mA) when V_{cc} is 15V. The relay coil current is additional to these values.

When the circuit is used to switch 250V lamps on and off, it is normally more convenient to employ a small power pack which operates from the mains.

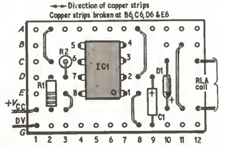

Fig. 3. Board layout for the flasher circuit

Components

Resistors
R1* 220k Ω, 1/10W, 10%
R2* 470k Ω, 1/10W, 10%

Capacitors
C1* 10µF, 15V electrolytic

Miscellaneous
NE555V (or NE555T) Signetics integrated circuit
OA47 gold bonded germanium diode.
MS1B relay, 6V or 12V coil (see text).
Mains three-way input plug if needed.
One or two two-way output connectors (depending on whether one or two sets of lights are to be switched).
Eight pin dual-in-line socket (if NE555V used).
* Values may be altered to obtain desired switching times.

POWER PACK

T1 Small mains transformer with an output of either about 5V or about 10V r.m.s., depending on the relay used (see text).
D1–4 1N4001 or similar or alternatively one bridge rectifier such as REC 41A (RS Components Ltd.).
250µF capacitor, 15V, electrolytic.

The whole system can then be operated from a supply which is switched off at a preset time at night by the normal type of time switch used for controlling the lighting in many shop windows.

A suitable power supply circuit is shown in Fig. 2. The output of the secondary winding of the transformer T1 should be chosen so that it is suitable for the coil operating voltage of the relay used. A 5V r.m.s. transformer winding is suitable for a relay with a 6V coil rating, whilst a 10V r.m.s. winding may be used with a 12V relay. However, these voltages are not very critical.

The output voltage of the transformer may be rectified by four separate diodes (D1 to D4), such as type 1N4001. Alternatively a single bridge rectifier (such as the RS Components type REC 41A) may be used instead of the four diodes.

CONSTRUCTION

The whole unit, including the mains power pack, may be placed in a small die-cast metal box. One suitable box of approximate external dimensions 114 × 89 × 55mm is available from RS Components Ltd., whilst another type of approximate dimensions 119 × 93 × 52mm is available from Eddystone Radio Ltd.

The metal box should be connected to the mains earth when used with mains equipment for safety reasons. The small mains transformer can be mounted directly on the box, but the remaining components are conveniently mounted on a small circuit board. One can solder directly to the contacts of the 555 integrated circuit, but it is generally more convenient to employ an eight-pin dual-in-line socket if the NE555V is used.

In view of the simplicity of the circuitry and mechanics involved it is deemed unnecessary to discuss construction in greater depth on this project. ★