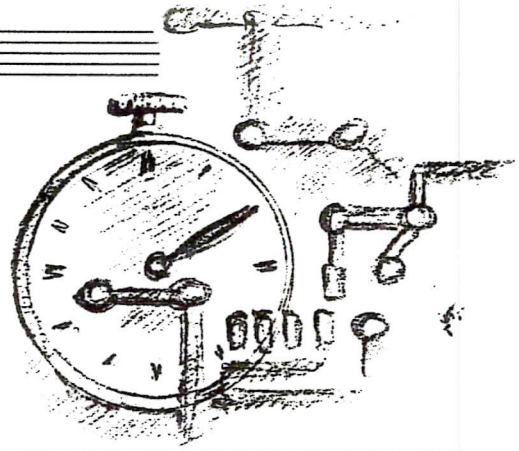
Constructional Project

UV EXPOSURE TIMER



ALAN WINSTANLEY

You will only obtain consistent results if your "light sensitive" p.c.b. receives the right exposure. Covers a time period of 2 to 24 minutes in two minute steps.

WHEN producing printed circuit boards (p.c.b.s) with the more advanced ultra-violet processing system, it is necessary to expose a sensitised board to a UV light source through the artwork positive.

Exposing the board for too long a period will rarely cause any damage, but troublesome problems can be caused by *under-exposure*, when the UV sensitive coating will not have thoroughly reacted to the UV light. This will only become apparent when you try to develop the board, because it will be impossible to remove all of the unwanted resist coating. The surface of the etch-resist ink might wash off in the developer but a layer of ink can still be left on the board, because the UV light has not had enough time to penetrate all the way through the resist.

Under these circumstances, all you can do is to try to re-align the board on the artwork and expose it for a further period, but you may well have to scrap that attempt and start again with a freshly-coated board. Further information is given in the *"Making Your Own Printed Circuit Boards"* series.

MAKING TIME

In order to obtain consistent results, it is best to expose the board for a timed period, though only the more expensive UV Light Boxes have a built-in timer.

The UV Exposure Timer described here enables the constructor to operate an ordinary UV Light Unit for a predetermined period (from 2 to 24 minutes, in two-minute steps) and will then automatically turn off. You can use this time to prepare the developer, etchant etc., or carry out any other tasks.

Using the timer also means that you can experiment to optimise the exposure times with different makes of sensitised boards and not worry about under- or over-exposure. You will certainly need to experiment with exposure periods if you are coating your own boards with a UV sensitive aerosol lacquer.

CIRCUIT DESCRIPTION

The full circuit diagram for the UV Exposure Timer is given in Fig. 1 and is seen to be based around a simple 555 timer chip IC1, wired as a monostable. The time period is determined by the resistor network R5 to R15 which are switched through S2.

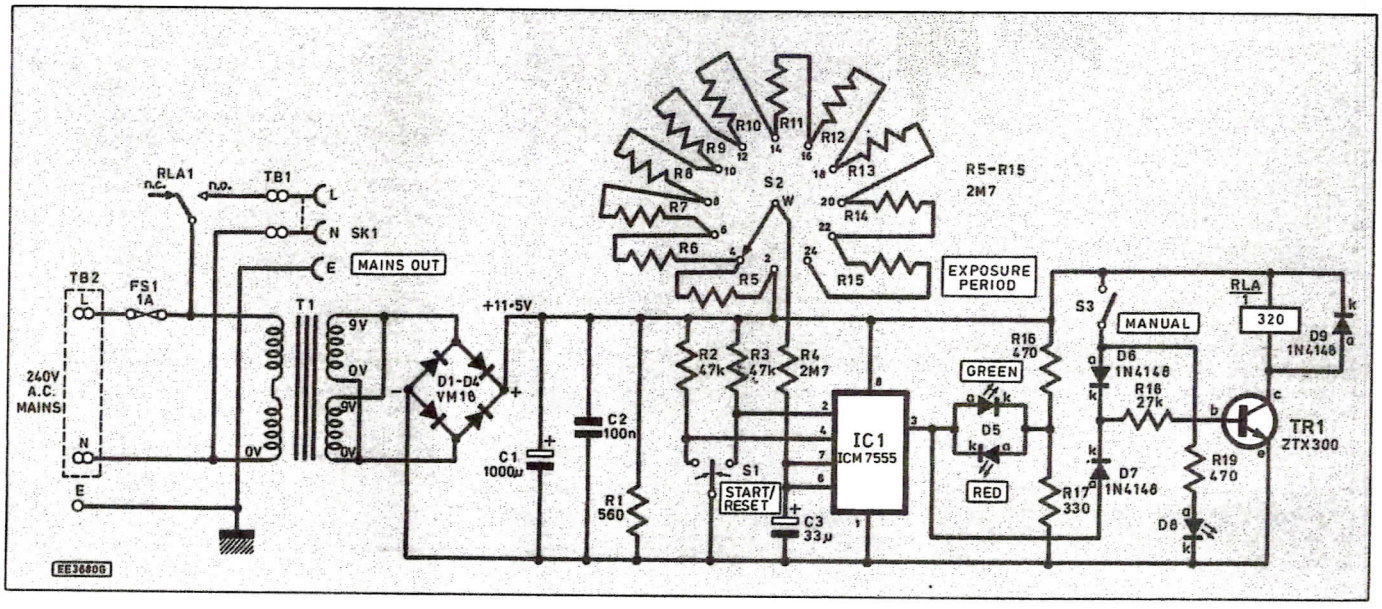
Rotating the switch S2 increments the monostable period by almost exactly two minutes, as measured on the prototype. The unit generates delays of between 2 and 24 minutes, which should cover every eventuality.

Since the 555 timer IC1 can be both triggered and reset by grounding pins 2 and 4 respectively, these functions have been combined into one control S1, a single-pole biased centre-off toggle. When IC1 is enabled, the output at pin 3 goes high, the l.e.d. D5 glows green and changes back to red when the period is up.

The 555 also drives a mains relay RLA through the transistor buffer TR1. The relay contacts RLA1 switch on the UV Exposure Light Unit, which is connected to the Timer via the miniature mains socket SK1. It is possible to manually operate the UV "Light Box" by operating switch S3, which completes the circuit to the relay coil and also illuminates D8.

The whole circuit is driven by a simple mains power supply and associated components. The circuit is fused, along with the mains load connected to SK1, by a 1A quick-blow fuse FS1.

Fig. 1. Complete circuit diagram for the UV Exposure Timer. A Light-Box is connected to the timer via the "Mains Out" socket SK1.

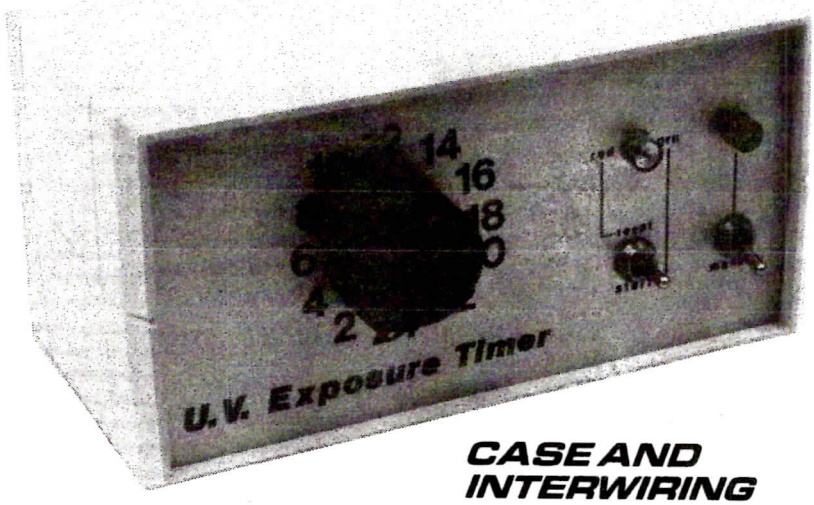


CONSTRUCTION

In order to simplify construction, nearly all parts are mounted on a single-sided glassfibre printed circuit board, measuring 110mm x 68mm. This board can be purchased from the *EE PCB Service* code EE792), but you might want to make it yourself! The actual design of the p.c.b. artwork is discussed in Part 3 of *"Making Your Own Printed Circuit Boards"* and may be of interest to the constructor.

The 1:1 (full size) artwork positive of the underside copper foil master pattern and topside component layout is shown in Fig. 2. It can be seen that all the mains parts, except socket SK1, are mounted on the board which greatly simplifies the interwiring, also making the unit that much more reliable.

Both the mains transformer and the relay MUST possess pinouts which match the p.c.b., and only the specified components (see *Shoptalk*) should be used in this respect. Other parts may not fit the p.c.b. artwork given, though the constructor making his own board can easily adapt the artwork to accept any components which he has available, provided that the electrical characteristics match those specified.



CASE AND INTERWIRING

The p.c.b. was designed to fit an instrument box measuring 155mm x 79mm x 91mm which has a clip-together plastic top and bottom with drop-in aluminium front and rear panels. The board is secured to the base section with M3 mounting hardware.

The front panel carries the switches, and the timing resistors are soldered directly to the tags of the rotary switch S2 as shown in Fig. 3. The two light-

COMPONENTS

Resistors

R1	560 ½W	
R2, R3	47k (2 off)	
R4 to R15	2M7 (12 off)	
R16	470	
R17	330	
R18	27k	
R19	470	

See SHOP TALK Page

All 0.25W 5% carbon film except R1.

Capacitors

C1	1000µ radial elect. 25V
C2	100n polyester
C3	33µ radial elect. 16V

Semiconductors

D1-D4	VM18 100V 0.9A d.i.l. style bridge rectifier
D5	5mm bi-colour l.e.d.
D6, D7	1N4148 signal diode (2 off)
D8	5mm red l.e.d.
D9	1N4148 signal diode
TR1	ZTX300 *npn* silicon
IC1	NE555V or ICM7555 timer i.c.

Miscellaneous

T1	p.c.b. mounting transformer, twin 120V primaries, 0V-9V, 0V-9V secondaries 6VA total
RLA	min. mains relay s.p.c.o. 3A a.c., 320 ohm 12V coil
FS1	20mm p.c.b. mounting fuseholder with 1A quick blow fuse
S1	s.p.c.o. miniature toggle switch biased both ways to centre off
S2	Single-pole 12-way rotary switch
S3	s.p.s.t. min. toggle switch
SK1	Euro-style miniature panel mounting mains safety socket

Case, Vero Apollo S3 beige, size 155mm x 79mm x 91mm; mains rated, p.c.b. mounting, 2-way screw terminal block (2 off); 8-pin d.i.l. socket; l.e.d. lens clip, one each-transparent and red; 6A 3-core mains cable; cable retention gland; 6A connecting wire; single-core connecting wire; p.c.b. mounting hardware; pointer knob; solder etc.

Printed circuit board available from *EE PCB Service*, code EE792.

Approx cost guidance only **£20** *excluding case*

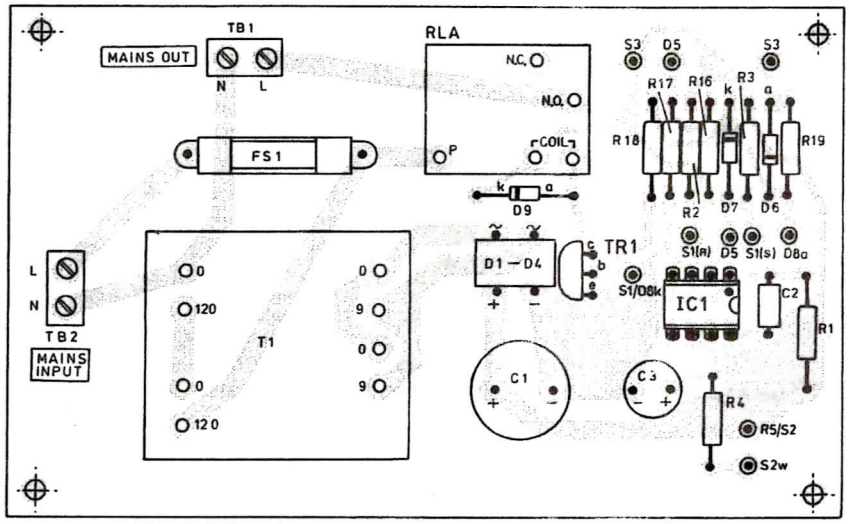


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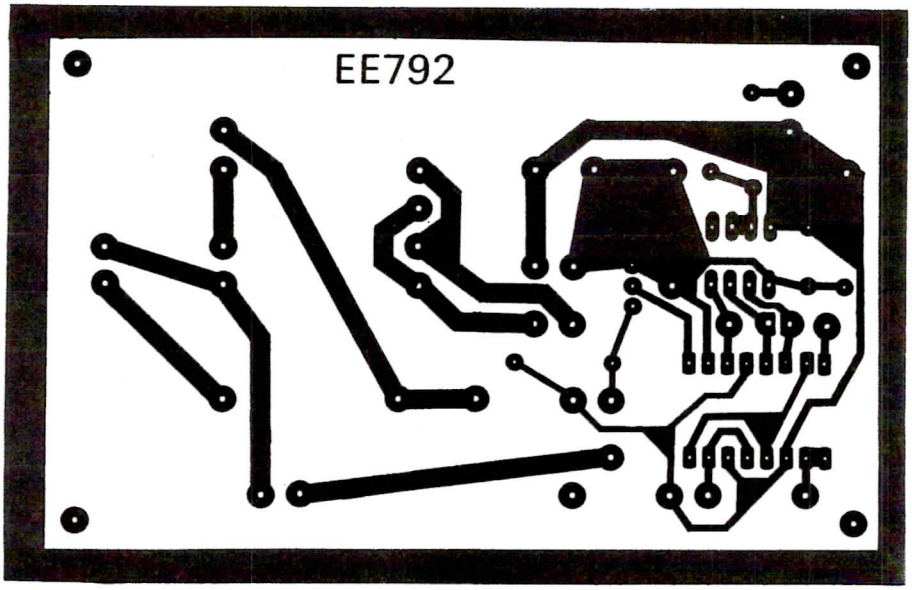
Fig. 2. Printed circuit board component layout and full size copper foil master pattern.



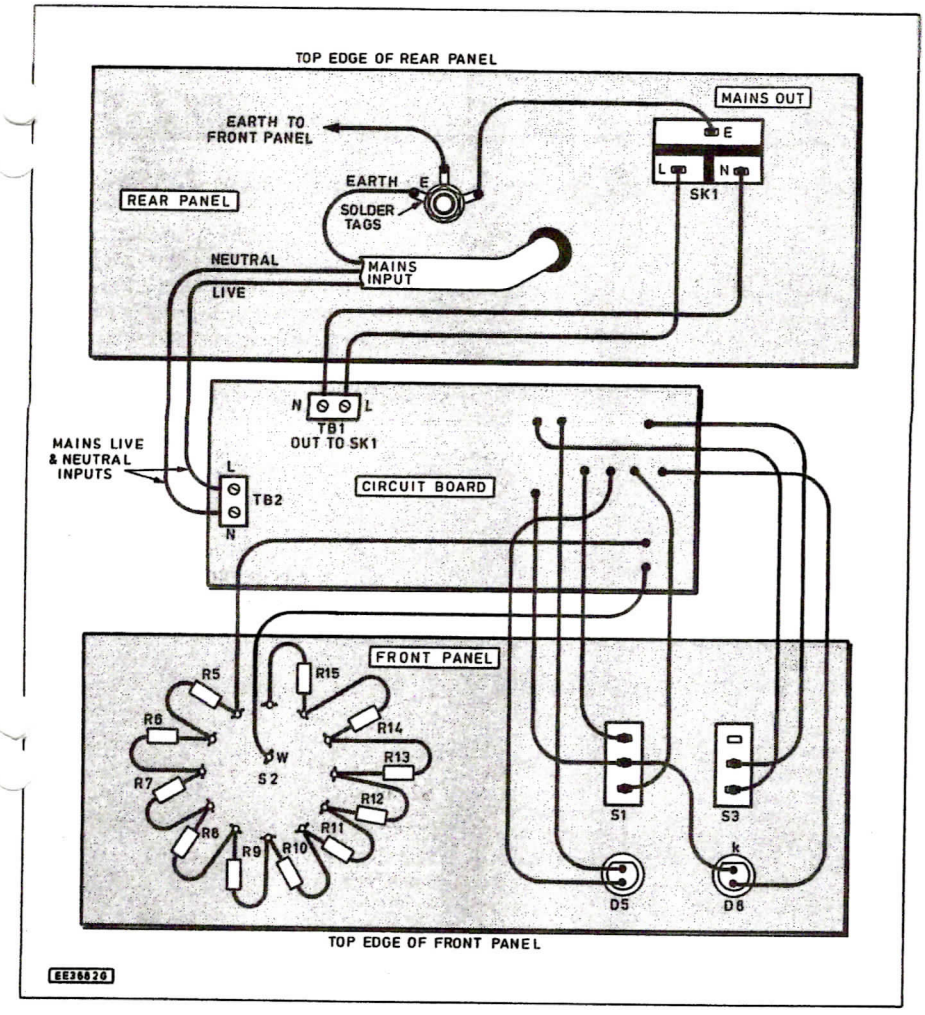
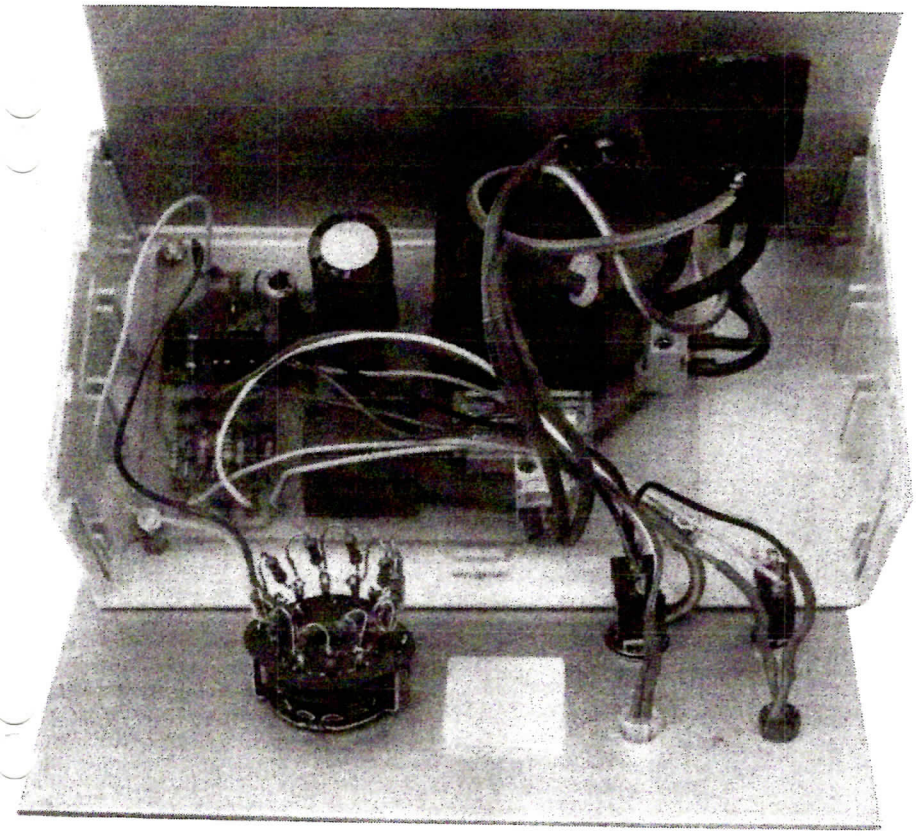


Fig. 3. Interwiring from the circuit board to the front and rear panels. The Earth lead from the rear panel solder tag to the front panel can be "earthed" under either switch S1 or S3 mounting washer. The completed unit showing layout of components inside the case is shown below. Where the mains leads are soldered to the output socket SK1 the solder joints and tags should be covered with plastic sleeving.



emitting diodes D5 and D8 require either mounting bushes or lens-clips. The bi-colour l.e.d. can utilise a transparent lens-clip to good effect. You may wish to embellish the controls with rub-down lettering followed by a coat of spray-on protective lacquer as usual.

The interwiring is generally straightforward and is completed with general purpose hook-up wire. Six amp three-core mains flex is used for the mains input which connects straight to the p.c.b. You can, if you wish, for added safety wire an illuminated, double-pole, mains rocker or rotary switch between terminal block TB2 and the mains lead. The switch can be mounted on the front panel and will show when the unit is powered-up. The front and rear metal panels MUST be soundly Earthed as shown. A series of solder-tags is connected together with a countersunk mounting screw on the rear panel. The screws used for p.c.b. mounting must be nylon as they pass through the plastic case.

The mains output socket SK1 is a Euro-style snap-in type which is fitted into a suitable cutout on the rear panel. The mains inlet cable must be secured to prevent it from pulling out, and a cable gland or "P" clip can be used as normal.

TESTING

When all construction has been completed in accordance with the diagrams, check all interwiring etc. carefully, set the rotary switch to "2 Minutes" and then power up the unit. The bicolour l.e.d. D5 should glow red ("Reset" mode) and operating switch S1 to "Start" should change D5 to green and the relay should be heard to click in.

After the selected delay the relay will click out and the bi-colour l.e.d. D5 will revert to red. Finally, check that the "Reset" S1 and "Manual" S3 functions operate and the unit is then ready for use. The UV Light Unit is connected to the Timer with a miniature 3-pin plug to match SK1.

MAINS SUPPRESSION

The author's UV Light Unit contains two fluorescent tubes along with the usual control gear. It was occasionally found in practice that the timer would re-trigger when the light tubes were switched off when the timer timed-out, presumably caused by a switch-off "spike" on the supply.

The result is that the relay RLA is heard to click at the end of the timing period, but the timer re-starts as it is caused to re-commence timing for a further period.

This problem was entirely eliminated by adding a suitable R/C suppressor between the Light Unit and the Timer. A standard delta-capacitor type device was used which has a built-in inductor and bleeder resistor (Roxburgh suppressor type SDC051, rated 250V 5A).

In fact, since there was no room within the timer box to add the filter, a separate plug-in suppressor unit was built, which has the output wired to a miniature plug to mate with SK1: the unit has a 13A flush mounting socket into which the UV Light Unit is plugged. It is very simple therefore to plug the suppressor in-line.

Readers can determine whether or not any extra suppression is required with some simple usage tests, as it may not be necessary to go to the added expense of incorporating any spike suppressors, depending on the characteristics of the light unit used. □