# The FLICKER BOX

*Produce candle-like effects with ordinary incandescent bulbs*

*By William Russo*

HOW would you like an electric light that simulates the warm, old-fashioned glow of an oil lamp? The Flicker Box can create this effect and more. Its adjustable flicker intensity can produce both the wild gyrations of a ghostly Halloween light and the friendly dancing flame of a single candle. What's more, for those times when you prefer a steady light, the flick of a switch makes it a full-range light dimmer. You can build the Flicker Box for about $25.

**How It Works.** In the schematic shown in Figs. 1 and 2, a flicker generator circuit controls a thyristor-type light dimmer. Transformer *T1* and components *C1, D1, D2, D3, F1,* and *R1* provide unregulated 9 V dc and regulated 6.2 V dc. The four op amps of the LM324 *IC1* are configured as nearly identical square-wave generators, the only difference being in the values of feedback resistors *R2, R7, R12,* and *R17.* These different values result in four different square-wave frequencies, chosen to best simulate an open flame.

Resistors *R6, R11, R16,* and *R21* add the square waves to produce a pseudorandom flicker voltage. This flicker voltage is applied to incandescent bulb *I1* through driver transistor *Q1* and calibration potentiometer *R23.* The light from the lamp is optically coupled to photocell *PC1.* Bias resistor *R22* keeps the lamp voltage above the minimum to which the lamp filament will respond, thus increasing the useful dynamic range of the circuit.

The photocell, with its resistance modulated by the flicker voltage, is connected in parallel with the potentiometer of a conventional full-wave 117-V ac dimmer. The dimmer pot provides control of the steady background light level, while the photocell adds the flicker effect. Switch *S1* turns off the flicker generator and opens the photocell circuit when the flicker is not desired. The dimmer switch serves as the master switch that can be used to turn off both dimmer and flicker generator.

**Construction.** Figure 3 shows the pc foil pattern for the Flicker Box and Fig. 4 shows the parts placement on the pc board. Other construction methods can be used since circuit layout is not critical. The optocoupler consisting of *I1* and *PC1* can be constructed by mating an incandescent bulb to the face of a photocell using clear glue. (It can also be purchased as a single unit.) After the glue dries, wrap the assembly with black electrical tape to seal out ambient light.

The dimmer is the usual type that replaces a wall switch. To modify it for use here, first remove the plastic case that is held to the metal front panel by two fasteners in diagonally opposite corners. Remove these

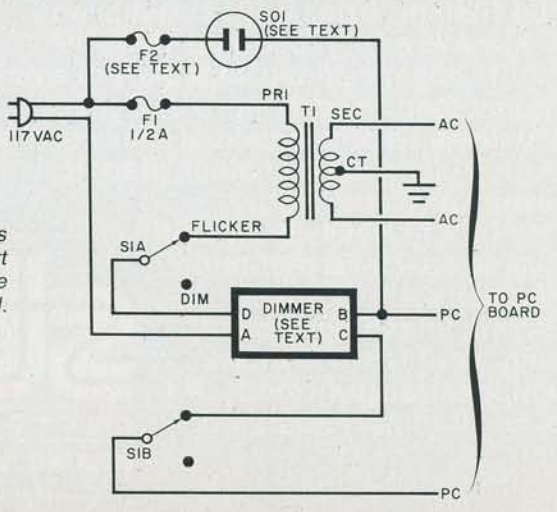


*Fig. 1. Components shown in this part of schematic are mounted off the board.*

fasteners (drill out rivets, pry out pins, or unscrew, as necessary) and the plastic case should come off. You'll see a pot with a switch on it, a thyristor using the front panel as a heatsink, and a few other small components. One of the two black wires emanating from the dimmer is connected to a terminal on the switch. This one is labeled A in the schematic; the other is labeled B.

The pot is usually wired, rheostat fashion, with the center lug shorted to one of the end lugs, or with one of the end lugs left disconnected. Don't use the shorted or open-end lug, and do not disturb the lug to which wire B is attached. A length of insulated hookup wire should be soldered to the remaining lug, being careful not to damage or disconnect any dimmer components already soldered to it. The new wire goes to *S1* as wire C in the schematic. Wire D is connected to the dimmer-switch terminal not occupied by wire A.

The line cord and outlet for the controlled lamp come from a 9′ extension cord cut 3′ from the receptacle end. The 6′ piece is used as the line cord and the 3′ section is wired for the load as shown in the schematic. Fuse *F2* is optional (it protects the dimmer) and should be rated at the maximum dimmer current as listed on the dimmer. A typical 600-W dimmer requires a 5-A fuse.

The prototype unit was built into a 7.5″ × 4.3″ × 2.2″ plastic case. A plastic case is used rather than a metal one to minimize the chance of shock. It should be big enough to provide adequate clearances. Drill a ⅜″ access hole in the box for *R23* adjustment, and mount the assembled board so that the *R23* control is accessible through this hole. You can fasten the dimmer switch to the top of the case, using the two holes provided for securing the dimmer to a wall switch box. All of the components of the prototype unit, except *S1*, were glued to the top of the box with epoxy cement. This allows easy access to the circuitry while avoiding unsightly holes in the cover.

The line and load cords exit the box through notches filed in one end at the top. Doublecheck all wiring and close up the box before applying power. Remember that 117-V ac is present on the circuit board pc terminals as well as in the wiring inside the box.

**Calibration and Use.** Plug a 40-to-100-W lamp into the load receptacle. Now plug the Flicker Box line cord into an outlet and turn on the dimmer. With *S1* set to dim only, check the dimmer control for proper dimming operation. (Make sure the load lamp is turned on!) If

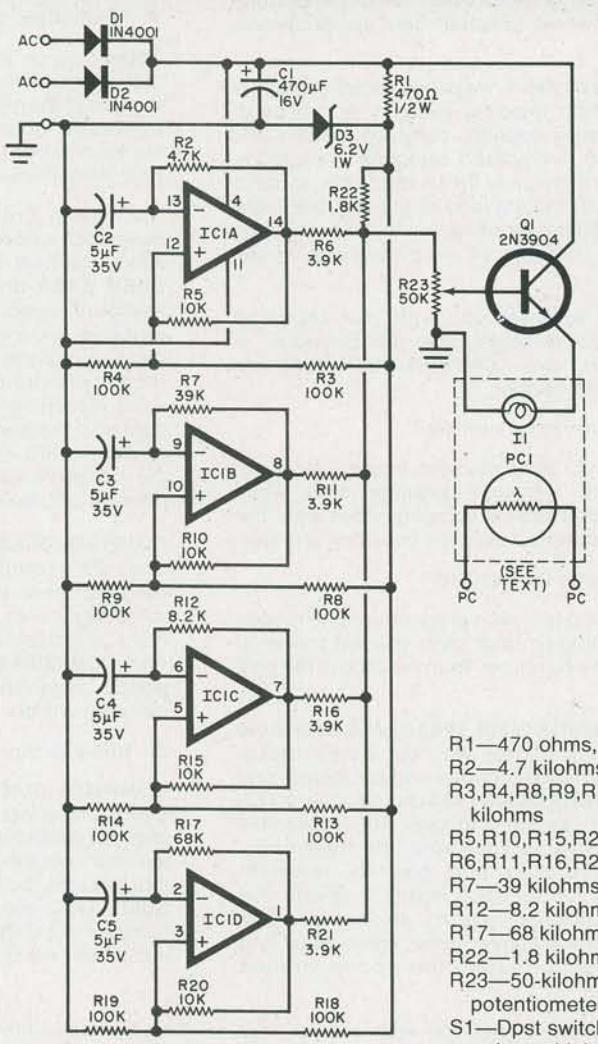


*Fig. 2. Four square waves of different frequencies are generated in the four op amps and combined to produce the pseudo-random flicker voltage.*

## PARTS LIST

C1—470-µF, 16-V electrolytic (axial leads)
C2,C3,C4,C5—5-µF, 35-V radial-lead electrolytic
D1,D2—1N4001 rectifier
D3—6.2-V, 1-W zener diode
F1—0.5-A regular-blow fuse
F2—See text
I1—12-V, 25-mA incandescent lamp (Radio Shack 272-1141 or equivalent. See Note 1)
IC1—LM324 quad operational amplifier
PC1—Photocell (Radio Shack 276-116 or equivalent. See Note 1)
Q1—2N3904 npn transistor
The following are ¼-W, 5% carbon resistors unless otherwise noted:
R1—470 ohms, ½ W
R2—4.7 kilohms
R3,R4,R8,R9,R13,R14,R18,R19—100 kilohms
R5,R10,R15,R20—10 kilohms
R6,R11,R16,R21—3.9 kilohms
R7—39 kilohms
R12—8.2 kilohms
R17—68 kilohms
R22—1.8 kilohms
R23—50-kilohm, linear-taper, trimmer potentiometer
S1—Dpst switch rated for dimmer current rating or higher
T1—Stepdown transformer, 115 V ac to 12.6 V ac center-tapped, 300 mA min.
Misc.—Dimmer (see text), case, line cord, load receptacle (see text), pc board, mounting hardware, fuse holders, hookup wire, IC socket (optional), pc board standoffs, solder, etc.

***Note 1: Suitable optocouplers to replace I1 and PC1 are Sigma 301T1-12B1 and VacTec VTL3A26.***

***Note 2: The following are available from JRJ Engineering, 2271 Mecklenburg Rd., Ithaca, NY 14850: etched and drilled printed circuit board at $6.50; optocoupler at $4.50; both pc board and optocoupler at $10.00. All prices postpaid in USA. New York state residents add local sales tax.***

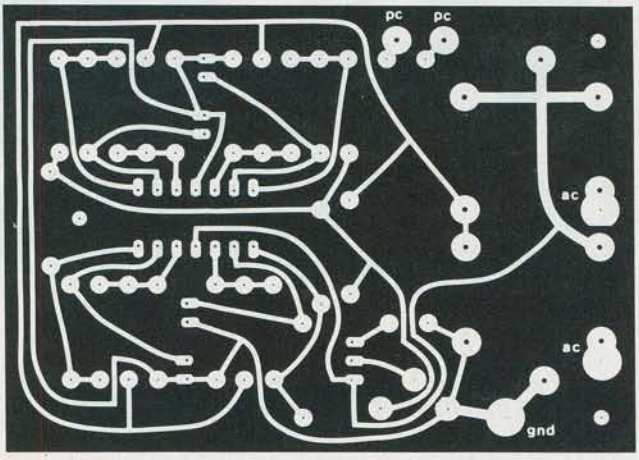


*Fig. 3. Use this foil pattern for the printed circuit board.*

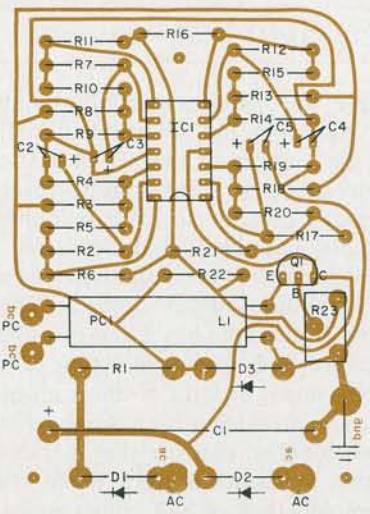


*Fig. 4. Layout of components on the printed circuit board.*

operation is satisfactory, turn the dimmer knob all the way counterclockwise so that the lamp is dark but the switch remains on. Now switch *S1* to FLICKER. If the lamp does not flicker, adjust *R23*, using a screwdriver through the hole in the case. Turn *R23* until the lamp intensity varies from full brightness to darkness. Then increase the flicker level a little until the minimum lamp brightness reaches a very low intensity, but the lamp never entirely goes out. The Flicker Box is now adjusted for best operation.

To operate the Flicker Box, first plug in your lamp (do not exceed the dimmer rating). Then, with the dimmer on and *S1* in FLICKER, adjust the dimmer pot for the desired appearance. The higher background level produced when the dimmer knob is turned up (clockwise) will give you less flicker. In general, larger lamps should use more flicker and smaller lamps less. For a grotesque spooky effect, the dimmer level can be set very low.

Here are a few suggestions for using the Flicker Box. For low-wattage candelabra lamps, use minimum flicker. Start with the dimmer fully on and back off until the flicker is just noticeable. For electric fireplace logs, more flicker is needed. To further increase realism, use two or three Flicker Boxes connected to separate colored lamps hidden in the synthetic logs. This produces a "dancing flame" effect. To add flicker to Christmas-tree lights use a Flicker Box for each string of lights and intermingle lights from different sets to create a random display.

For a jack-o'lantern or other Halloween prop, a high flicker level will give the spookiest results. For an even scarier effect, try adjusting *R23* for darkness between flickers. Play with the dark/light ratio until you're satisfied with the results. In any application you can control the overall light intensity by your choice of lamp wattage.

Finally, to change from a flicker back to a steady glow, just flip *S1* to DIM and dial the desired brightness. Your lamp may look the way it used to but it will never be the same again. ◇