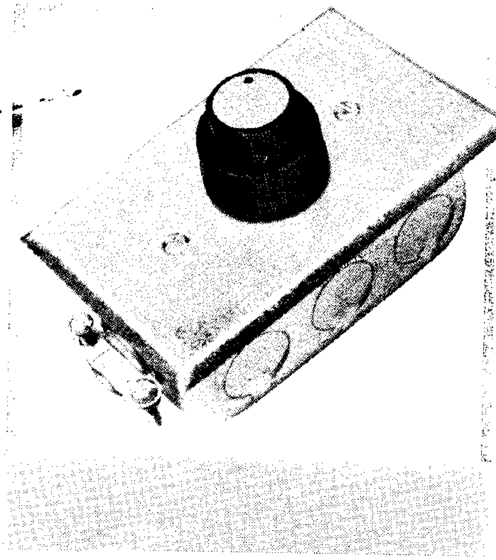


Build The DYNADIM

THE DIMMER WITH A DIFFERENCE

BY RUSSELL J. BIK

YOU'RE ENTERTAINING and would like the lights down low to set the "mood." But to have them there to start with or to lower them noticeably would spoil the effect. If your home lighting is equipped with the "Dynadim"—the dimmer with a difference—you're in business.

The Dynadim is an unobtrusive wall-mounted device that lets you dim room lighting to any preset level, even full off, automatically and at an almost unnoticeably slow rate. All you do is set a control for the dimming level desired and push in a knob.

Aside from its obvious use as a mood setter at parties, the slow extinguishing action of the lighting possible with the Dynadim can serve as a sleep inducer and a safety device in the home. For example, after setting the Dynadim for timed full off, you have ample opportunity to get into bed before the lights extinguish. So, stubbed toes, bruised shins, and even broken bones that result from collisions with furniture in the dark are eliminated.

If the extinguish rate is set for a sufficiently long time, the slow dimming action can help you to relax, making your eyes heavy-lidded. Before you know it, you're fast asleep. And the Dynadim is especially handy to have around when the kids insist that the lights be left on after they are put to bed.

How It Works. To obtain proper dimming action, the Dynadim must be connected in series with the a.c. power source and the load (lamp or fixture to be controlled) via terminals *A* and *B* in Fig. 1.

The power to the load is regulated by the dimmer, specifically by the triac *Q3*. The triac acts as a switch that closes at some point during each alternation of the input power. To cause *Q3* to conduct, a trigger pulse (produced by the discharge action of *C2* through *Q2* and the primary of *T1*) is applied to the gate of the triac. The triac continues to conduct for the remainder of the alternation.

The point in the alternation where *Q3* is triggered into conduction determines how much power is supplied to the load. If triggering is early, the lighting glows at a higher average intensity than if triggering is late.

The time constant of *R9* and *C2* is rather long compared to a single alternation. (The values shown were selected

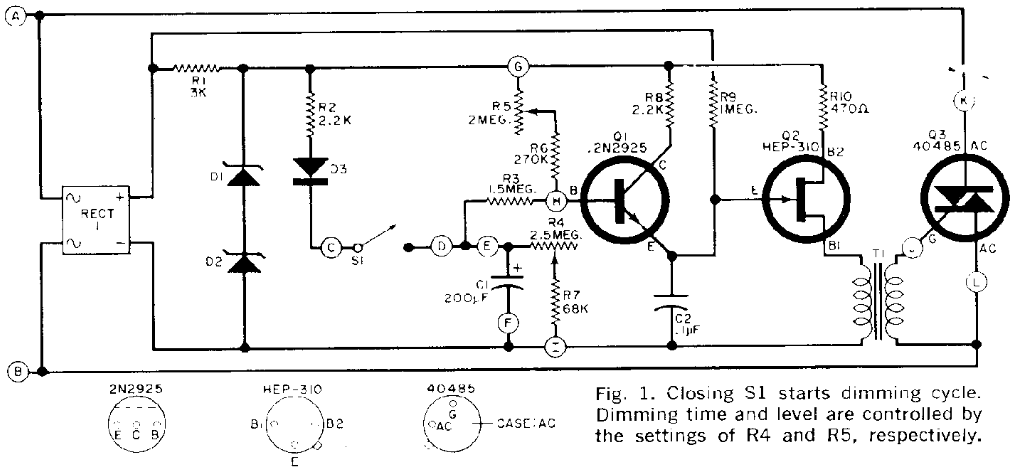


Fig. 1. Closing S1 starts dimming cycle. Dimming time and level are controlled by the settings of R4 and R5, respectively.

PARTS LIST

C1—200-µF, 25-volt electrolytic capacitor
C2—0.1-µF, 25-volt paper or mylar capacitor
D1, D2—12-volt, 1-watt zener diode (General Electric Z4XL12B or similar)
D3—HEP-154 diode (Motorola)
Q1—2N2925 transistor
Q2—HEP-310 unijunction transistor (Motorola)
Q3—40485 triac (RCA)
R1—3000-ohm, 5-watt resistor
R2, R8—2200-ohm, ½-watt resistor
R3—1,500,000-ohm, ½-watt resistor
R4—2,500,000-ohm, linear-taper potentiometer
R5—2,000,000-ohm, linear-taper potentiometer in tandem with R4
R6—270,000-ohm, ½-watt resistor
R7—68,000-ohm, ½-watt resistor
R9—1-megohm, ½-watt resistor
R10—470-ohm, ½-watt resistor
RECT1—VS-248 bridge rectifier assembly
S1—S.p.s.t. switch, push-pull type (part of R4-R5 combination)
T1—1:1 pulse transformer (Sprague 11Z12)
Misc: General Electric #14-10 heat spreader; Scotch #27 glass-cloth tape; 1⅞" X 3¾" heatsink mounting plate; printed circuit board; dual concentric knobs; hookup wire; solder; hardware; etc.

The following parts are available from Pacific Circuit Systems, Box 1281, San Luis Obispo, Calif. 93401. Etched and drilled printed circuit board, $2.25; complete kit including parts, printed circuit board, and machined mounting plate, $14.95 (residents of California, add 5% sales tax).

so that the potential across *C2* just barely attains an amplitude sufficient to drive *Q2* into conduction when zero voltage is across *C1*, and *R5* is set for maximum resistance.)

Closing *S1* causes the voltage across *C1* to rise, increasing the biasing of *Q1* and raising the potential across *C2*. The charging curve of *R9-C2*, therefore, begins from a slightly higher potential on each successive a.c. power cycle. As a result, oscillator *Q2* produces the triggering pulses for the triac (*Q3*) slightly earlier in the cycle as *C1* charges through *D1* and *R2*.

An earlier triggering can also be obtained by reducing the value of *R5*. The effect on the bias of *Q1* is the same as that of raising the potential across *C2* except that a static control over lighting intensity is provided. A later triggering is obtained by opening *S1* and allowing *C1* to discharge slowly through *R4* and

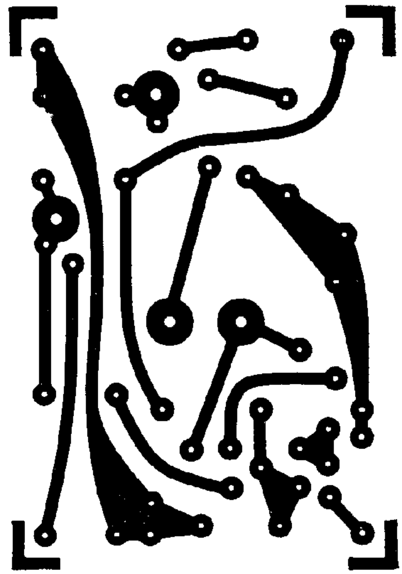


Fig. 2. Drawing shows, in actual size, the resist pattern to be copied if you make your own PC board.

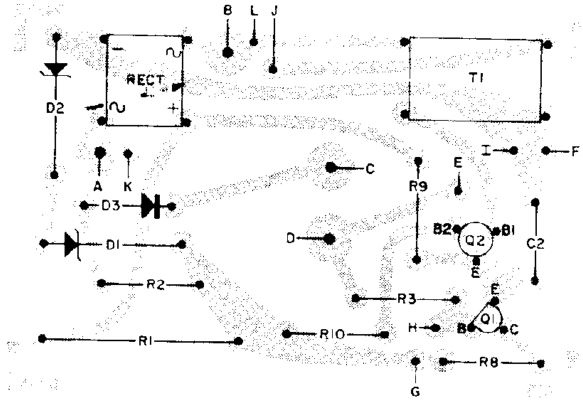


Fig. 3. Observe proper polarities when mounting diodes, transistors, triac, and rectifier assembly.

R7—the lighting diminishes as the triac triggering pulses are produced later and later in each cycle.

The high resistance necessary to prevent the voltage from being shunted away from *C1* too rapidly is obtained by inserting *R3* in the base circuit of *Q1*. The rectified power applied to the timing circuit from *RECT1* is maintained at a 24-volt level, regardless of changes in load, by zener diodes *D1* and *D2*.

Construction. The Dynadim was designed to be mounted inside a standard 4″ × 2″ junction box for wall mounting. Ample space is available inside the box for parts mounting and entrance of wires through both ends. For most permanent installations, the Dynadim's circuit simply takes the place of your present power switch. You can, however, mount the circuit inside a high-impact/heat-resistant plastic box (equipped with a power receptacle) for portable use.

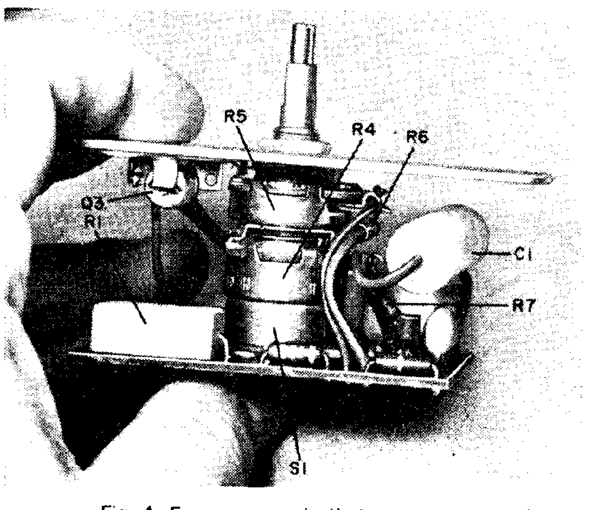


Fig. 4. For components that are not mounted flush with board, use insulated sleeving on exposed leads.

An aluminum mounting plate must be fabricated to support the exterior switch plate and serve as a heat sink for the triac. The plate should be just large enough to fit inside the front of the junction box and rest on the box mounting brackets. Two holes must be drilled and tapped in the mounting plate to facilitate mounting of the exterior switch plate. Then drill the holes for mounting the plate in the box and for the shaft of the control/switch assembly.

For maximum utilization of the space available, printed circuit board construction is recommended. If you plan to etch your own board, an actual-size etching guide is provided in Fig. 2. Component placement and orientation must be the same as that shown in the drawing given in Fig. 3. When all components are mounted and soldered to the board, cut off the excess leads close to the foil.

The potentiometer/switch assembly supports the circuit board as shown in Fig. 4. This is done by plugging the switch terminals at the rear of the assembly into the holes in the board. If necessary, bend these terminals to fit. Before final mounting and soldering, apply a bead of epoxy cement to the rear of the assembly to provide solid mechanical support. For maximum safety, also cement *T1* to the board (see Fig. 5).

Mount the parts that do not sit directly flush with the circuit board. Be sure to connect the positive lead of *C1* to hole E (negative to hole F). Resistors *R6* and *R7* connect from the wiper lug of *R5* to hole H and from the center lug of *R4* to hole I, respectively. Use insulated sleeving over the exposed leads.

The method recommended for mounting the triac is shown in Fig. 6. First carefully apply a thin film of solder to the underside of the triac's case. When cool, press the triac into the heat spreader, and apply enough heat to solder bond the two pieces together. Now apply a thick film of epoxy cement to the underside of the heat spreader, attach a 1½″ to 2″ long piece of heat-setting tape to the mounting plate opposite *R1*, and press the heat spreader onto the tape. Allow the cement to set over night; then slip insulated tubing over the leads of the triac and solder them in place.

It is recommended that you look over the circuit board carefully to make sure that all solder connections are good and all polarities are correct. Then check for short circuits to ground. (Ground, in this case, is the front mounting plate.) Temporarily connect a power cord and load to the Dynadim. (See first paragraph of "How It Works" section.) Apply line power, and check with an a.c. voltmeter to make certain that there is no voltage between the mounting plate and a cold water pipe ground. When you are satisfied that the circuit is safe, remove the power and disconnect the load and line cord.

The next step is to cut the power feed to the switch that the "Dynadim" is to replace. Make absolutely certain that the 117-volt a.c. line is "dead" before removing the switch. Remove and set aside the wall plate and switch, and locate and identify the power and load wires inside the junction box.

Connect the appropriate wires to holes A and B on the circuit board as described earlier. Then twist tightly together the remaining load and line wires and secure them with an electrical wire nut. When the wire nut is in place no bare wire must be allowed to show.

Finally, mount the Dynadim in the junction box. Carefully arrange the wires so that they do not interfere with any of the components. Replace the exterior switch plate, and set the dual-concentric knobs onto the control shafts.

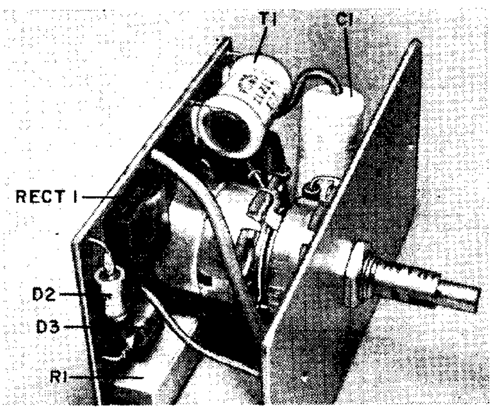


Fig. 5. Capacitor C1 should be oriented so that it sits between transformer T1 and the mounting plate.

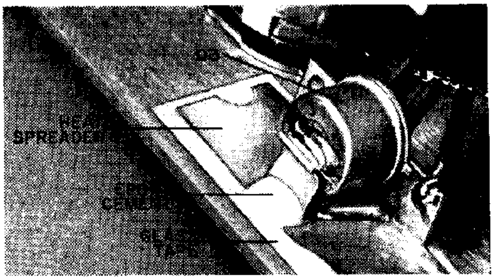


Fig. 6. Epoxy cement and glass-tape anchor insulate Q3 from front plate, provide maximum heat transfer.

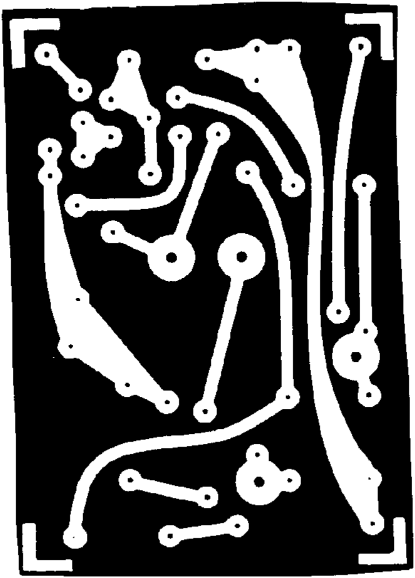
How To Use. Although conventional on/off control over lighting is sacrificed with the use of the Dynadim, the sacrifice is not great. When properly operated, the lights can be switched off and become fully extinguished—even from full on—in a matter of a few seconds.

For dimming action, a great deal of flexibility can be obtained from the Dynadim's extremely simple controls. For example, if you wish the lights to be full on and extinguish to a very dim glow over a period of say, 10 minutes, the following procedure would be followed: First rotate both concentric knobs fully counterclockwise, and push in on the smaller knob. The lights will extinguish quickly. Then, adjust the large knob to the position that gives the desired minimum illumination. Set the smaller control to a position about 2/3 clockwise, pull out until the lights come up to full intensity, and push in. It may be necessary to experiment with the setting of the smaller knob to obtain the exact time.

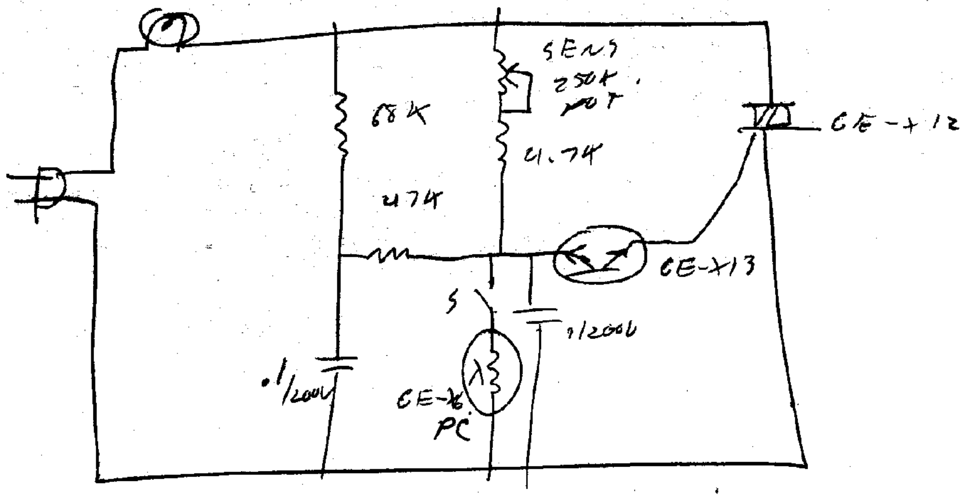
In general, dimming action is obtained by the above procedure. It may be a good idea to "calibrate" the controls (two concentric circles, for example) so that experimentation is unnecessary. The inner circle could be calibrated in minutes, and the outer for intensity—high; medium-high; medium; medium-low; etc.

If longer dimming times are desired, they can be obtained by increasing the values of *C1* and/or *R7*. As a rule of the thumb, the dimming time is equal to 7/8 of the time in seconds obtained by multiplying the value of the capacitor in microfarads by the sum of the resistances of *R4* and *R7* in megohms.

The "Dynadim" draws very little power when it is off. It can be treated like any electric clock or night light. —30—



Automatic control to brighten lights slowly.



Automatic with S closed. - Manual with S open.

Keep PC away from the light bulb.