BY STEVEN E. MARGISON

Stage Lighting for the Amateur

CONTROLS 1500 WATTS PER CHANNEL WITH PRESET STORAGE, CROSS FADING, AND SUBGROUPING

WHETHER it's the graveyard scene in "Our Town" or "June Is Busting Out All Over" in "Carrousel," one of the main concerns of the amateur (community, off-off-Broadway, etc.) producer is the lighting effects. Fortunately for everyone, the days of the cumbersome, creaky rheostats are gone—replaced by the era of silicon controlled rectifiers, Triacs, and other semiconductor devices.

Many little theatre groups now use the General Electric Triac modules, which are available in capacities of 6, 10 or 15 amperes. As in all things, however, there are improvements and circuit variations that can be made to enhance the overall effect. Here are some of the modifications that can be made.

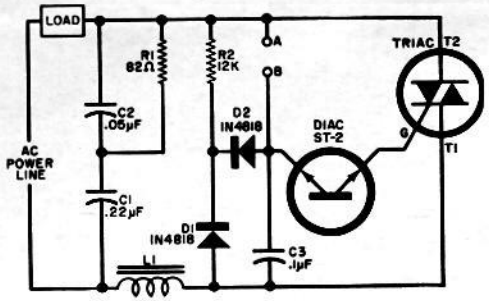
The circuit in Fig. 1 shows the basic wiring of the GE Triac assembly (except that *R2*, *D1*, and *D2* have been added). The added components prevent the "snap on" effect which usually occurs when the dimmer is first energized.

In Fig. 1, the usual potentiometer control has been removed from the circuit, and the circuit shown in Fig. 2 is connected to the terminals marked A and B. The use of the circuit in Fig. 2 provides a master control function and permits safe remote operation since the controls are powered by low-voltage dc.

Master Control System. The heart of the control circuit is a photocell-lamp combination. When the lamp is illuminated, the resistance of the photocell goes down, and vice versa. Transistor *Q1* can handle up to 3 amperes so that it can control as many as 25 dimmers. Potentiometer *R4* is the master control while *R3* and *R6* are trimmers for initial setup. Switch *S1* is used to turn the control off and to select either independent or master control.

Potentiometer *R7* is the actual dimmer control, while *R8* and *R9* are trimmers. Potentiometers *R4* and *R7* are mounted on the front panel; other controls are within the cabinet. Transistor *Q2*, preset by *R1*, is used to set the voltage on the independent line to the same value as the voltage on the master line.

To insure long life, transformer *T1* and *RECT1* should be selected to give more power than required. For instance, a 10-dimmer system requires a 1-ampere transformer; but a 1.5-ampere unit is better. The current rating of the transformer (at 10 volts) can be found by multiplying the number of dimmers by 0.1.



PARTS LIST

C1—0.22-μF, 200-volt capacitor
C2—0.05-μF, 200-volt capacitor
C3—0.1-μF, 200-volt capacitor
D1,D2—1N4818 diode
DIAC—ST-2 (General Electric)
L1—2" x ¼" ferrite core wound with double layer of #14 heavy Formvar magnet wire.
R1—82-ohm, ½-watt resistor
R2—12,000-ohm, ½-watt resistor
TRIAC—To suit load current
Note—All parts mounted on ⅛" thick aluminum, minimum area 12 sq in.

Fig. 1. Schematic of 1500-watt commercial dimmer module (except for R2, D1, and D2).

Construction. Most circuit breakers are not fast enough to protect the Triacs, so fast-acting fuses should be used. A good choice is the 3AB type, which is the ceramic version of the conventional 3AG. A better, though more expensive fuse, is the KAA rectifier fuse.

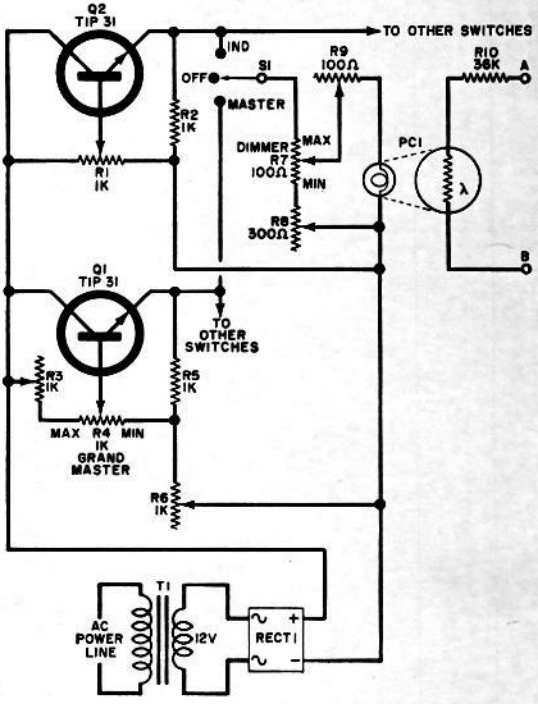
The two transistors must be mounted on heat sinks using mounting insulation. The photocell/lamp assembly should be mounted within the control cabinet with the long leads connected through *R10* to points A and B on the Triac module.

To avoid switching transients and radio frequency interference, use appropriate shielding and grounding in the modules and the associated wiring. Switching transients affect other dimmers in a manner called "tracking", which occurs only when several dimmers are operated at very low intensities. A slight change in the setting of one or more dimmers will correct the problem.

If there are problems with mechanical noise emanating from the dimmers, do not shock mount them to reduce the noise. This increases their internal heat and may result in early failure.

If the dimmers are not overloaded or short-circuited, the only damage they can suffer is from excessive heat. Make sure that the dimmer cabinet is well ventilated and that the modules are mounted on a heavy aluminum plate. The addition of a small, quiet fan will also help. The fan should be mounted to exhaust air from the cabinet and should be connected so that it goes on as soon as *T1* receives power.

If desired, a set of panel lights, operating on the 10-volt dc line and controlled by a 100-ohm potentiometer can be used. Treat each lamp as if it were a dimmer in determining transformer and rectifier capacity.



PARTS LIST

PC1—Vactrol VT10150 photocell lamp module (do not substitute)
Q1,Q2—Transistor (TIP31 or TIP31A)
R1,R3,R6—1000-ohm, ¼-watt trimmer potentiometer (Mallory MTC13L1)
R2,R5—1000-ohm, ½-watt resistor
R4—1000-ohm, linear taper, ½-watt potentiometer (Mallory U4)
R7,R9—100-ohm, 5-watt potentiometer (Mallory VW-100)
R8—300-ohm, 5-watt potentiometer (Mallory VW-300)
R10—36,000-ohm, ½-watt resistor
RECT1—50-100-volt rectifier module, current to match T1
S1—Spdt switch (Switchcraft 3034L)
T1—12-volt filament transformer (see text for current ratings)
Misc.—Heat sinks (Wakefield NC-633-3B), knobs (National HRS-3), suitable chassis, line cord, mounting hardware, etc.

Fig. 2. Remote control circuit to operate the phase-shift network in the Triac module.

Initial Adjustment. Adjustment is not critical, but it does require some patience to get the best results. Always adjust one trimmer at a time, and use a lamp load equal to about 60% of the dimmer's rated capacity. Use the following procedure:

1. Turn off all *S1*'s and set all controls to zero.

2. Set *R3* and *R6* for maximum resistance and *R4* for full intensity.

3. Connect the positive lead of a dc voltmeter to the emitter of *Q1* and negative lead to ground. Apply power.

4. Adjust *R3* to get a voltage indication of 5.5.

5. Set *R4* to minimum and adjust *R6* to get a 2.5-volt indication. Repeat steps 4 and 5 until *R4* varies the voltage between 2.5 and 5.5.

6. Set *R4* for full intensity. Set *R9* for maximum resistance and *R8* at 50%. Connect load to dimmer under adjustment and *S1* to MASTER position.

7. Set *R7* to maximum and adjust *R9* until the lamp no longer increases in intensity.

8. Set *R7* slightly off zero and adjust *R8* until the dimmer just begins to hum. Leave this setting for about 30 seconds. If the dimmer drifts either up or down, readjust *R8* until the humming is sustained, but as low as possible.

9. Repeat steps 7 and 8 for each of the other dimmers. Make sure that dimmers not being adjusted are off.

10. Set *R4* for maximum and any other dimmer to maximum (*S1* on MASTER) and read the voltage as in step 3. Move the positive voltmeter lead to the emitter of *Q2* and adjust *R1* for the same reading. Be sure to have one dimmer set to INDEPENDENT when making this adjustment.

Readjustments should not be necessary unless parts are replaced. However, if the unit receives a great deal of use, readjustment after the first 100 hours may be necessary to correct for component aging. On rare occasions, *R8* may not have enough resistance to bring the blackout point of the dimmer below 1 or 2 on the knob scale. If this happens, insert a 150-ohm, 1-watt resistor in series with *R8* and proceed with the adjustment. Since *PC1* never operates above 50% of its rated voltage, it should last many years, but a few spares should be kept on hand. The *R7* controls may get slightly warm during use, but this is normal. ◆

THE NEXT COMMUNICATIONS SATELLITE?

Next generation of international communications satellites may look like this one proposed by Lockheed Missiles & Space Co. Large flex-rib antennas, horn antennas and telemetry antennas flank a model of the earth (background) on this model. In the foreground is the apogee kick motor to put the spacecraft into circular geosynchronous orbit at 22,300 miles altitude. The rectangular box contains batteries, communication relay systems and station-keeping hardware. Lockheed has been studying the satellite configuration for the Communications Satellite Corp. (COMSAT) and the Interim Communications Satellite Committee of the International Telecommunication Satellite Consortium (INTELSAT).