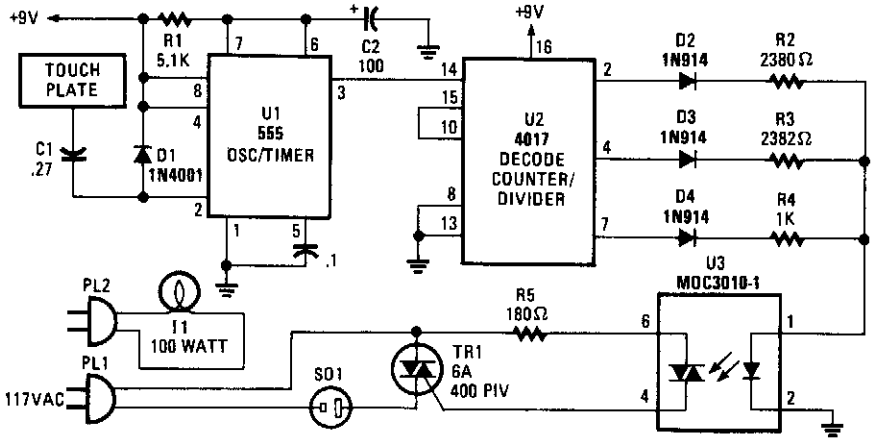
43

Light-Control Circuits

The sources of the following circuits are contained in the Sources section, which begins on page 668. The figure number in the box of each circuit correlates to the entry in the Sources section.

Three-Way Touch Lamp
Light Dimmer/Speed Control
Four-Quadrant Dimmer
Light Dimmer
Automatic Emergency Lighting Unit
Lights-On Sensor
Light Chaser I
3-Way Light Control
Light Chaser II
Light Controller
"Automatic" Light Bulb Changer
Inductive Load Triac Switch
Christmas Light Driver
SCR Capacitor Turn-Off Circuit

THREE-WAY TOUCH LAMP



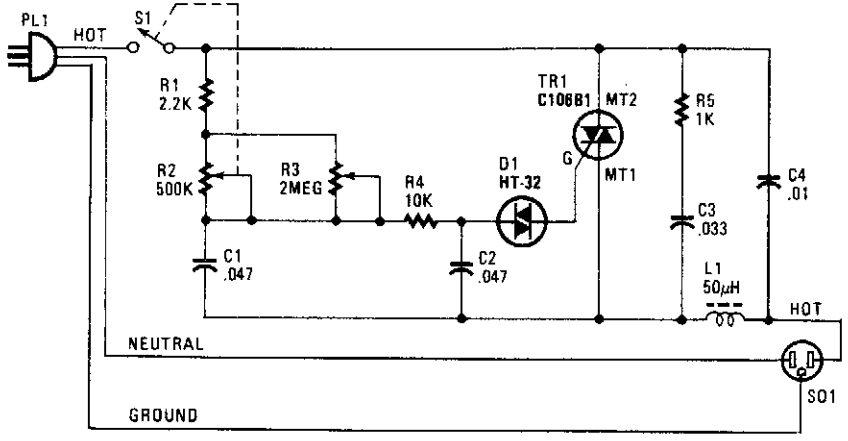
POPULAR ELECTRONICS

Fig. 43-1

A three-way switch to control a lamp (off-dim-bright, etc.) uses an NE555 timer to generate a one-second pulse, triggered by ambient ac fields that are picked up by the human body. C1 and D1 form an input network. U2 is a decode counter/divider and drives one of 10 outputs (three are used). The logic outputs drive various resistors in series with the LED in the optocoupler. The optocoupler controls a triac that is in series with a load (lamp, etc.).

By reconfiguring the outputs of U2, more than three brightness levels can be obtained, up to 10. An IN914 and resistor will be required for each output.

LIGHT DIMMER/SPEED CONTROL

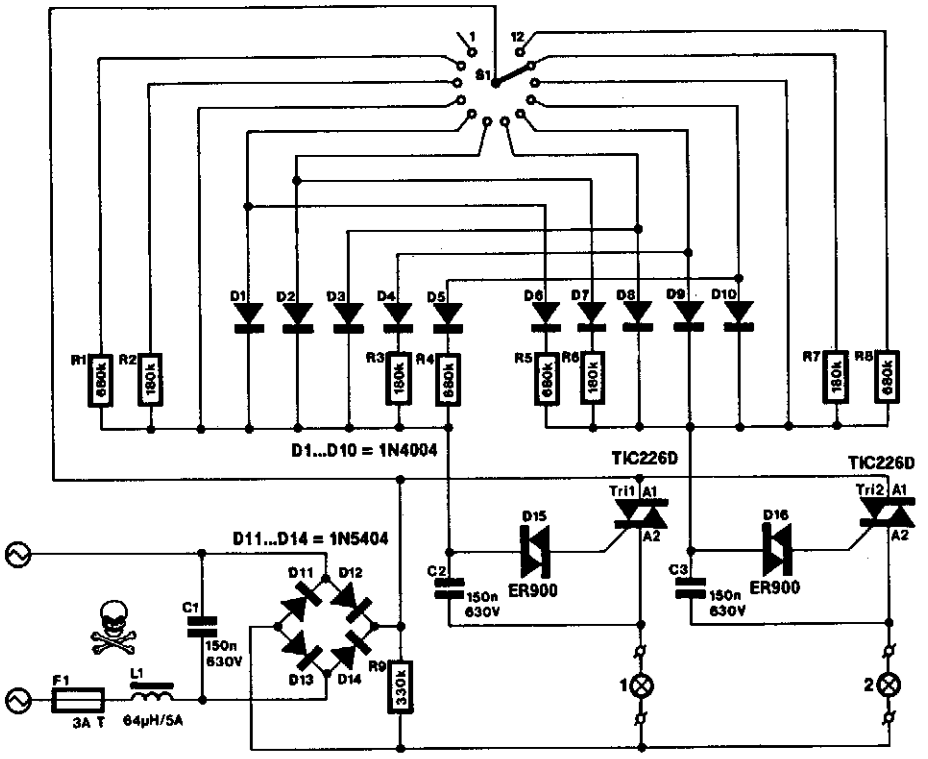


POPULAR ELECTRONICS/HANDS-ON ELECTRONICS

Fig. 43-2

A phase-controlled triac (HT-32) circuit provides control of effective voltage at load. Do not omit L1 and C4 because they are for RFI suppression. The maximum load is about 500 W. WARNING: 120 Vac is present on this circuit—provide adequate insulation and construction techniques.

FOUR-QUADRANT DIMMER



Switch position	Brightness	
	Group A	Group B
1	0	0
2	1/3	0
3	2/3	0
4	1	0
5	1	1/3
6	1	2/3
7	1	1
8	2/3	1
9	1/3	1
10	0	1
11	0	2/3
12	0	1/3

ELEKTOR ELECTRONICS

Fig. 34-3

FOUR-QUADRANT DIMMER (*Cont.*)

This very special mains-operated dimmer for domestic or industrial lights is not available in proprietary form: it enables brightness control of two groups of lights in one operation. The possible combinations of brightness are shown in the table. It will be clear that it is not possible to obtain continuous brightness control in the two groups. Instead, the circuit affords the setting of four states of brightness in either group: full on, fully dimmed, 1/3 on, and 2/3 on.

Both sections of the circuit operate on the well-known principle of the triac being switched from the blocking state to the conducting state with the aid of an RC network and a diode. The RC network provides the necessary phase shift and determines when the triac is switched. The rotary switch selects the resistor in a given network, and thus the brightness of the relevant group of lights. No resistor means that the group is off; a short-circuit gives maximum brightness, and resistors of 10 kΩ and 18 kΩ produce intermediate brightness. The diodes prevent the groups from affecting one another.

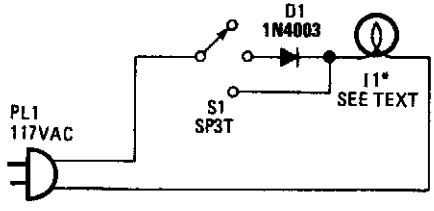
The 64-μH choke (L1) and the 150 nF capacitor across the bridge rectifier prevent the dimmer causing interference in other equipment connected to the mains.

If the triacs are fitted on a heatsink that is rated at 12° K/W, up to 500 W per group can be controlled. It is, of course, essential that the enclosure in which the dimmer is fitted provides ample cooling. A fair number of slots or holes in it are, therefore, essential; these should not permit the circuit elements to be touched.

The switch should have a nonmetallic spindle: this is not only safer than a metallic one, but it also enables the easy removal of the end-notch so that the switch can be rotated continuously, instead of having to be returned to the first stop every time it is operated.

The mains on/off switch S2 should be fitted with a built-in ON indicator bulb, which shows at a glance whether the circuit is on, even though S1 might be in the OFF position. Finally, remember that this circuit carries mains voltage in many places: good workmanship and insulation are, therefore, of the utmost importance.

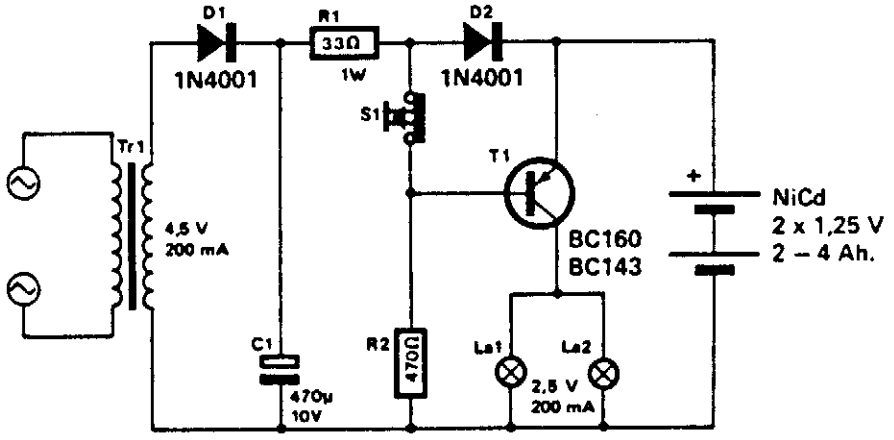
LIGHT DIMMER



POPULAR ELECTRONICS *Fig. 43-4*

Lamp I1 is a household lamp. When the switch is in the center position, the lamp is operated on half-wave rectified ac; the effective voltage the lamp sees is less, which dims it. I1 can be a lamp up to 200 W or 50 rated at 120 or 240 V, and D1 should be a 200-V PIV or better diode (400 PIV for 240-V operation).

AUTOMATIC EMERGENCY LIGHTING UNIT

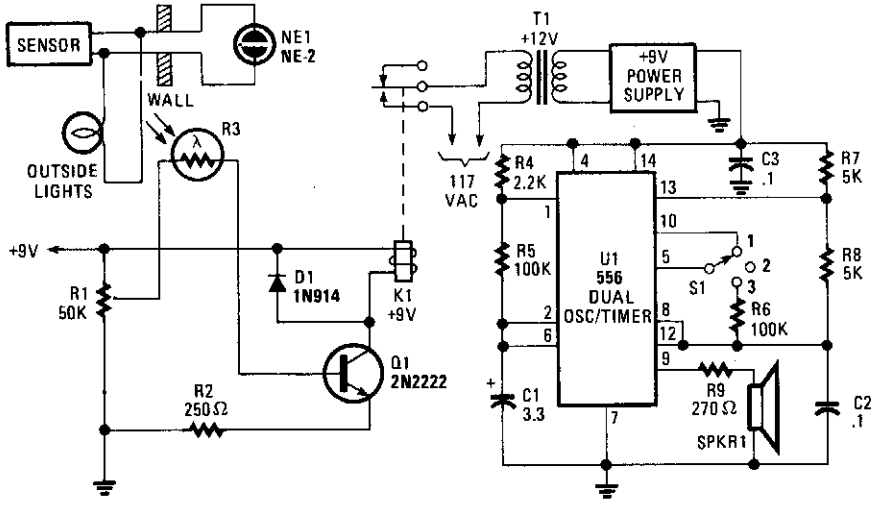


ELEKTOR ELECTRONICS

Fig. 43-5

This unit uses a Nicad battery to provide power to an emergency lighting setup. When power fails, T1 becomes forward biased, which lights L1 and L2. The batteries are normally kept charged. When power is on, T1 is cut off and it keeps the lamps extinguished.

LIGHTS-ON SENSOR

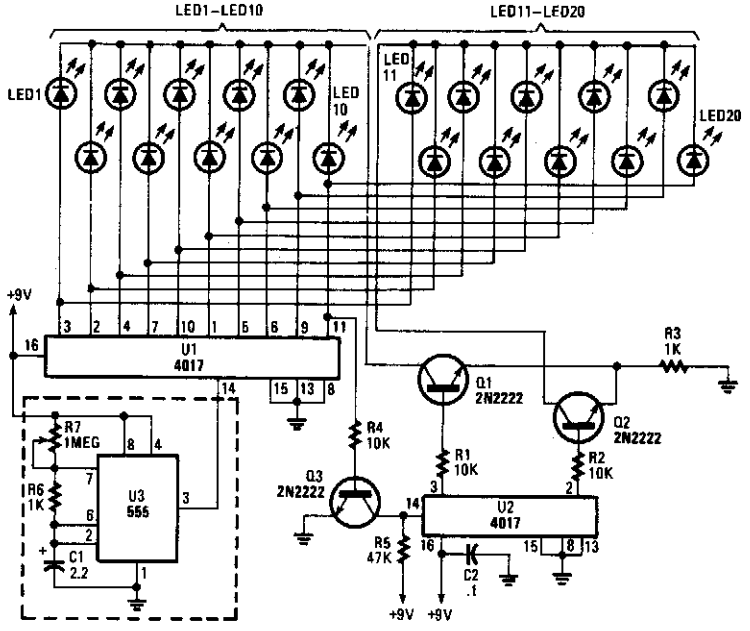


POPULAR ELECTRONICS

Fig. 43-6

Remote monitoring of a light source is possible with this circuit. Photocell R3 activates Q1 and relay K1. U1 is a tone generator that drives a small speaker.

LIGHT CHASER I

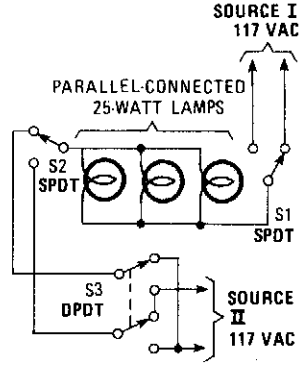


POPULAR ELECTRONICS

Fig. 43-7

Up to 100 lights, LEDs, or optocoupler triac circuits can be sequentially activated by this circuit. One (U1) 4017 decode counter sequences 10 LEDs whose common anode is returned through a second (U2) CD4017, which counts at one-tenth of the rate. The flash rate is controlled by U3, a clock circuit, with a 555 timer.

3-WAY LIGHT CONTROL

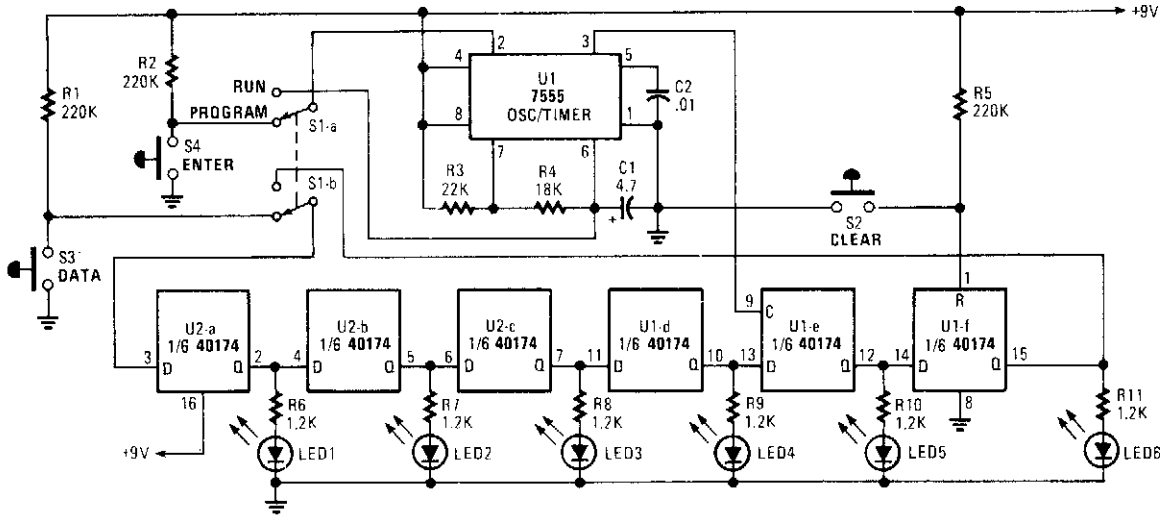


POPULAR ELECTRONICS

Fig. 43-8

This hookup is useful in some house wiring situations, where only two wires are available between switches, rather than the usual 3-way setup where 3 wires are required. S1 and S2 are ordinary three-way switches and S3, a DPDT switch, is commonly available as a four-way switch at hardware stores.

LIGHT CHASER II

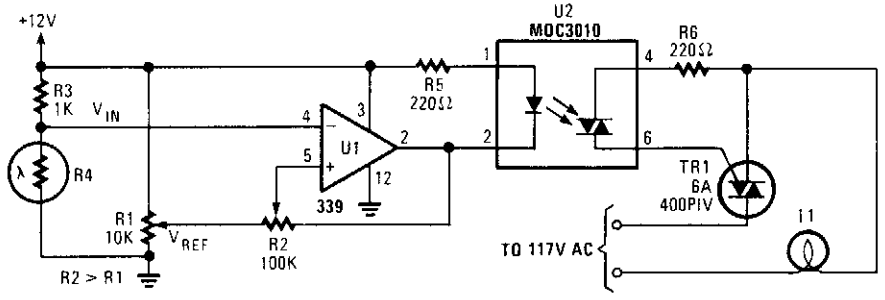


POPULAR ELECTRONICS

Fig. 43-9

Up to six lights can be sequentially flashed using this circuit. LED1 through LED6 can be replaced by optocouplers (MOC3010, etc.) to control 120-Vac loads via triacs. U1 generates pulses that clock the shift register mode up of the six D flip-flops in the CD 40174. By S1A–B, the register can be programmed either ON or OFF (low or high) and then switched to run in the programmed sequence. S2 clears the program.

LIGHT CONTROLLER

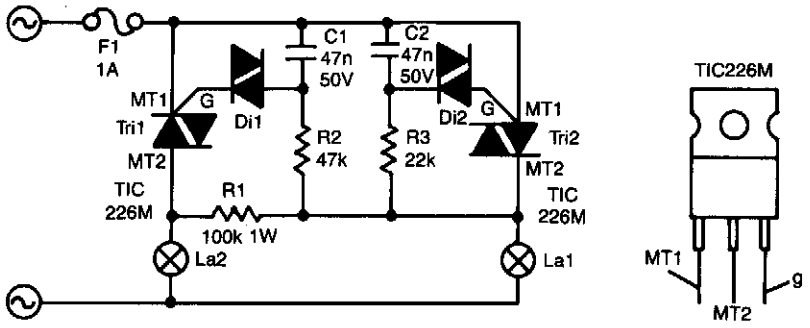


POPULAR ELECTRONICS

Fig. 43-10

A photocell drives U1, a comparator, which controls optocoupler U2. A 6A Triac is used to switch an ac load, such as a lamp, etc.

"AUTOMATIC" LIGHT BULB CHANGER



ELEKTOR ELECTRONICS

Fig. 43-11

The circuit presented here guarantees that if bulb La1 "gives up the ghost," bulb La2 will take over its task. In series with La1 is triac Tri2. Resistor R3 and C2 form a delay network. As soon as the voltage across C2 rises above about 30 V, diac (gateless triac) D2 is switched on, which causes Tri2 to conduct so that La1 lights.

The control circuit of La2 is parallel to that of La1, but because R2/C1 has twice the delay of R3/C2, Tri1 will not be triggered when Tri2 conducts; C1 discharges so that Tri1 cannot be triggered.

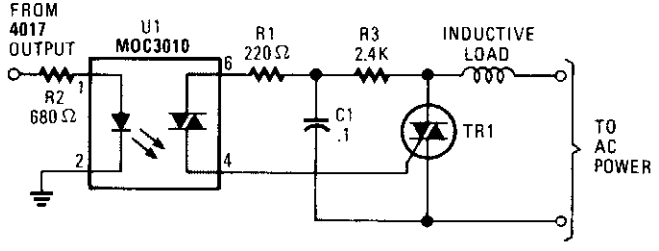
When, however, La1 is open-circuited, a voltage is across both RC networks via La2 and R1. Again, Tri2 will be triggered first, but because the current is smaller than its holding current, it will cease to conduct almost immediately. Capacitor C1 will then continue to charge and after a little while Tri1 is switched on.

Because the time constant for La2 is somewhat longer than that for La1, La2 will always be slightly less bright than La1. It is, of course, possible to give La2 a slightly higher wattage than La1 to ensure equal brightness.

Without heatsinks, the triacs can handle up to 100 W each; with heatsinks, powers of up to 1 000 W can be accommodated. It is not recommended to use bulbs with a wattage below 25 W, because these can flicker.

The triacs can be any type that can handle at least 400 V at no less than 5 A. The M types used in the prototype can handle 600 V at 5 A.

INDUCTIVE LOAD TRIAC SWITCH

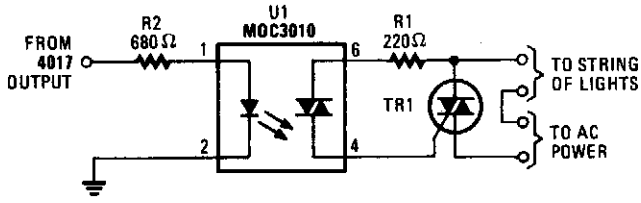


POPULAR ELECTRONICS

Fig. 43-12

An additional resistor and capacitor enable control of an inductive load, such as a small blower motor, fluorescent lamp, etc.

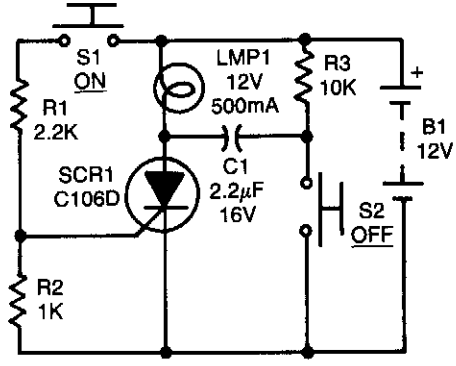
CHRISTMAS LIGHT DRIVER



POPULAR ELECTRONICS *Fig. 43-13*

This circuit will enable a CMOS logic chip, such as a 4017 decode driver, to control a string of Christmas lights or other lighting. The triac should be rated at 200 V and 3 A or higher. The 4017 should be powered from at least 10 V to ensure adequate drive to the optoisolator.

SCR CAPACITOR TURN-OFF CIRCUIT



RADIO-ELECTRONICS *Fig. 43-14*

After the SCR turns on, C1 charges up to almost the full supply voltage via R3 and the anode of the SCR. When S2 is subsequently closed, it clamps the positive end of C1 to ground, and the charge on C1 forces the anode of the SCR to swing negative momentarily, thereby reverse-biasing the SCR and causing it to turn off. The capacitor's charge bleeds away rapidly, but it has to hold the SCR's anode negative for only a few μs to ensure turn-off. C1 must be a nonpolarized type.