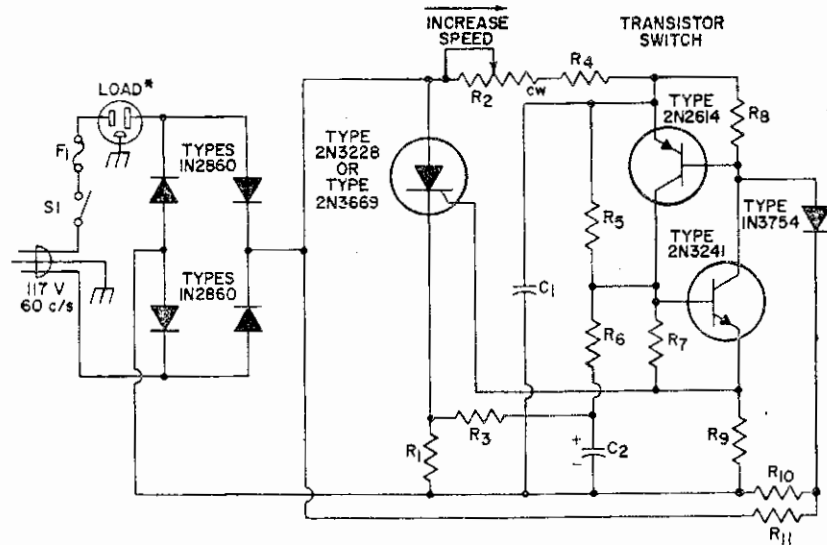


12-33 UNIVERSAL MOTOR SPEED CONTROL OR LIGHT DIMMER



* Maximum load is 2 amperes when 2N3228 SCR is used or 12.5 amperes when 2N3669 SCR is used.

Parts List

$C_1 = 1.0 \mu\text{F}$, paper, 200 V
 $C_2 = 50 \mu\text{F}$, electrolytic, 15 V
 $F_1 =$ fuse, 3-ampere (with 2N3228 SCR) or 15-ampere (with 2N3669 SCR)
 $R_1 = 2$ volts divided by rated value of the load current (as given on motor faceplate). The

load current squared times the calculated value of resistance plus a 50-percent safety margin is the recommended wattage rating for the resistor.
 $R_2 =$ potentiometer, speed adjustment, 0.1 megohm, 2 watts, linear taper
 $R_3 = 100$ ohms, 0.5 watt

$R_4, R_{10} = 1000$ ohms, 0.5 watt
 $R_5 = 5600$ ohms, 0.5 watt
 $R_6 = 4700$ ohms, 0.5 watt
 $R_7 = 470$ ohms, 0.5 watt
 $R_8 = 150$ ohms, 0.5 watt
 $R_9 = 15$ ohms, 0.5 watt
 $R_{11} = 15000$ ohms, 1 watt
 $S_1 =$ toggle switch, single-pole, single-throw

Circuit Description

This circuit can be used to provide both speed control and speed regulation (constant speed under conditions of changing loads) for ac/dc universal motors which have nameplate current ratings up to two amperes with a 2N3228 SCR or up to 12.5 amperes with a 2N3669 SCR. Motor speed can be adjusted from complete cutoff to essentially the

full rated value. The circuit also provides smooth anti-skip operation at reduced speeds. This control circuit is useful for adjusting and regulating the speed of small power tools (e.g., drills, buffers, and jigsaws) as required for special jobs.

The speed of the power-tool motor is determined by the time during each half-cycle of the ac input signal that

12-33 UNIVERSAL MOTOR SPEED CONTROL OR LAMP DIMMER (cont'd)

Circuit Description (cont'd)

the SCR conducts. This time, in turn, is controlled by manual adjustment of potentiometer R_2 . When R_2 is set for minimum resistance, the rectifier current from the four 1N2860 rectifiers charges capacitor C_1 rapidly to the triggering potential of the two-transistor regenerative switch (preset to six volts for this circuit), and the switch is triggered into conduction early in each input half-cycle. When the 2N2614 and 2N3241 transistors used in the switch circuit conduct, C_1 discharges through the series circuit of the transistors and the gate electrode of the SCR. This discharge current triggers the SCR into conduction, and load current then flows until the end of the input half-cycle. This operation is repeated for each succeeding half-cycle of the ac input signal, and the motor is maintained at maximum speed.

When the resistance of R_2 is increased, C_1 charges more slowly and the SCR is triggered later in the input half-cycle, or not at all if the charge on C_1 fails to reach six volts. Thus, the speed of the motor is reduced, or is cut off completely in the maximum-resistance position.

The feedback circuit (R_1, R_3, R_6 , and C_2) maintains essentially constant speed of the motor under changing load conditions. As the load is applied to the motor, the speed momentarily decreases and the current through the motor and the SCR increases. Resistor R_1 , in series with the SCR, develops an increased voltage drop, and the charge on capacitor C_2 is increased. This increased charge produces a current increase

through resistor R_6 ; less current is then required through resistor R_3 and the regenerative transistor switch. As a result, the SCR is triggered earlier in the next half-cycle of the input ac voltage. The increased conduction time results in a corresponding increase in motor speed approaching that set by means of the potentiometer R_2 . Resistor R_6 performs an additional function of this circuit, i.e., it shunts out commutator "hash" and thereby eliminates the possibility of premature triggering of the SCR.

The circuit can also be used to provide continuous and smooth control of the brightness of incandescent lamps. Lamps having a total power rating of 240 watts (with the 2N3228 SCR) or of 1500 watts (with the 2N3669 SCR) can be adjusted from complete cutoff to essentially full rated brightness. As a lamp dimmer, the circuit is useful for providing the exact amount of light required at different times in various locations, i.e., the desired level for any mood or occasion.

When the circuit is used as a lamp dimmer, speed regulation is not required, and capacitor C_2 and resistors R_3 and R_6 in the feedback network may be omitted. Lamp brightness is controlled in essentially the same way that the speed of a universal motor is controlled. The brightness of the incandescent lamp load is determined by the time during each half-cycle of the ac input that the SCR conducts. This time, in turn, is controlled by manual adjustment of potentiometer R_2 .