

SCR zero-cross trigger limits maximum load power

by Richard Eckhardt
Electronics Consulting & Development, Cambridge, Mass.

A zero-cross trigger for a silicon controlled rectifier will limit the maximum power delivered to a load if it is made to fire the SCR only on alternate cycles of the ac line input. Such an SCR triggering circuit is useful for driving loads rated at less than 110 volts. There are two advantages to limiting SCR conduction in this way—large amounts of power do not have to be wasted through dissipation, and the load can be powered continuously without the need for a power transformer.

With a zero-cross trigger, the SCR is fired only when the voltage across it is at or near the zero point in the driving ac waveform or pulsating dc waveform. Zero-voltage firing minimizes the generation of noise spikes that may occur when the voltage and current to the load are changed too rapidly.

The zero-cross trigger shown here employs a general-purpose operational amplifier as a comparator. The control-voltage input varies the power applied to the

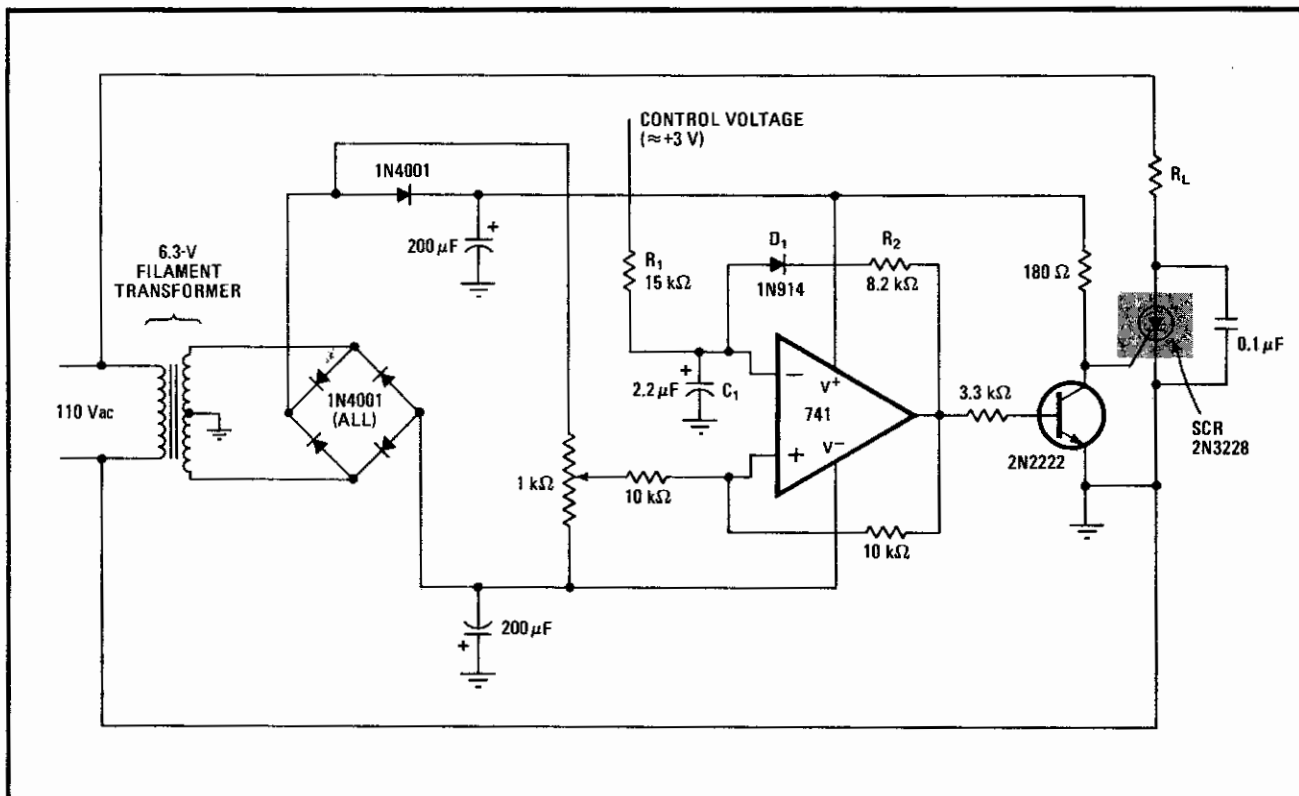
load by governing the ratio of SCR on cycles to SCR off cycles. To increase the power supplied to the load, the control voltage is made larger.

Some of the pulsating dc voltage produced by the rectifier bridge is applied to the noninverting input of the op amp. The control voltage, which goes to the op amp's inverting input, charges capacitor C_1 through resistor R_1 until the capacitor's voltage exceeds the minimum point of the pulsating dc voltage.

When this happens, the output of the op amp goes negative, switching off the transistor and permitting the SCR to fire. Since the SCR is triggered at the minimum point of the pulsating dc voltage, the SCR turns on only when the ac voltage across it is at or near zero. The output of the op amp remains low until capacitor C_1 discharges through diode D_1 and resistor R_2 .

This capacitor must be charged again by the control voltage before the SCR can be fired again. The charging time of capacitor C_1 determines how many successive cycles of the input voltage are included in the interval between SCR firings.

The circuit's dynamic range is established by the resistance ratio of charging resistor R_1 to discharging resistor R_2 . □



Power limiting without power waste. Because this zero-cross trigger fires its SCR only on every other cycle of the ac line, the maximum power delivered to the load can be limited without the need for a power transformer or wasteful power dissipation. The control-voltage input determines the ratio of SCR on cycles to SCR off cycles. The larger the control voltage is, the greater the power to the load.