

Negative feedback keeps LED intensity constant

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In applications where a passing object is detected as it partly obscures a light beam, a light source with a constant intensity may be desirable. A light-emitting diode, which has a longer life and switches faster than an incandescent lamp, would also be desirable, if it weren't for the fact that its light intensity may vary with temperature, especially as the device ages. But a LED's light intensity can be kept constant by the circuit shown here.

Light intensity is regulated by a silicon planar photovoltaic diode, D_2 , the ac response of which is almost constant with temperature or time. Its current is converted to voltage by amplifier A_2 and resistor R_7 . This diode is connected in a short-circuit mode to minimize its dark current.

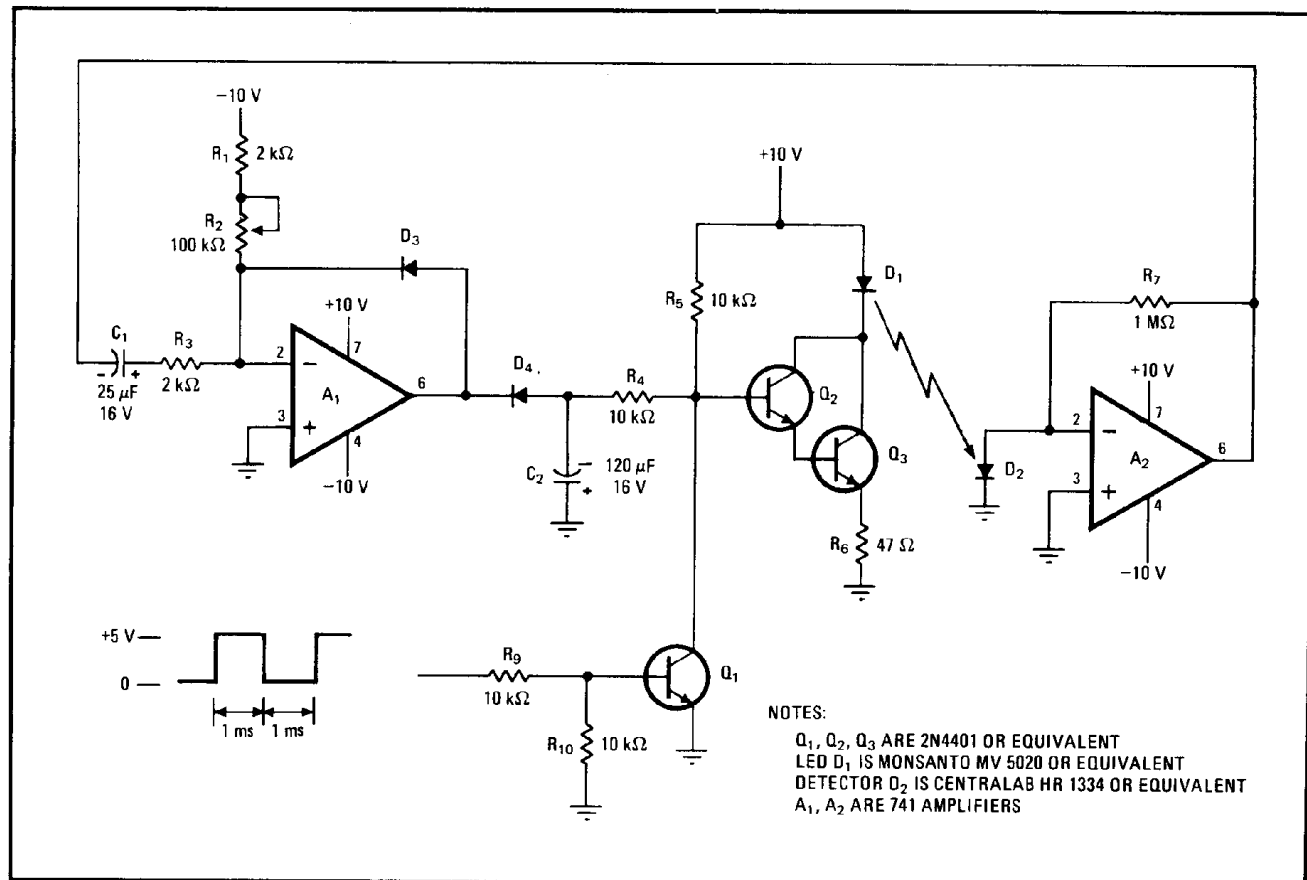
D_1 , a light-emitting diode, is driven by Darlington-

connected transistors Q_2 and Q_3 ; its current is proportional to the voltage at the base of Q_2 . Transistor Q_1 , which is driven by a positive-going square wave, chops the dc level at the base of Q_2 so that it operates in an ac mode.

When the capacitively coupled output of amplifier A_2 is positive, amplifier A_1 charges capacitor C_2 , when necessary, to maintain the current through R_3 equal to the current through R_1 and R_2 . Because the current through R_1 and R_2 is constant, the amplitude of the square-wave signal at the junction of C_1 and R_3 is held constant.

When the output of A_2 is negative, the capacitively-coupled output of amplifier A_1 goes positive, but is clamped to 0.7 volt by diode D_3 . This clamping maintains the output of the amplifier in the active region so that a virtual ground potential is maintained at its summing point. The light intensity level is adjusted by potentiometer R_2 . The peak-to-peak voltage at the output of amplifier A_2 is held at $40/(R_1 + R_2)$ volts, where R_1 and R_2 are in kilohms.

Diode D_2 can be mounted near the LED, but to one side of the direct beam, so that it picks up enough light to generate the feedback signal but doesn't interfere with the primary detection function. □



Steady glow. Feedback loop senses variations in output of light-emitting diode, which may occur as temperature changes. Photodiode response is almost constant with temperature; it is amplified, and signal controls another amplifier whose output controls LED drive circuit.