A Tracking Photocell Pickoff

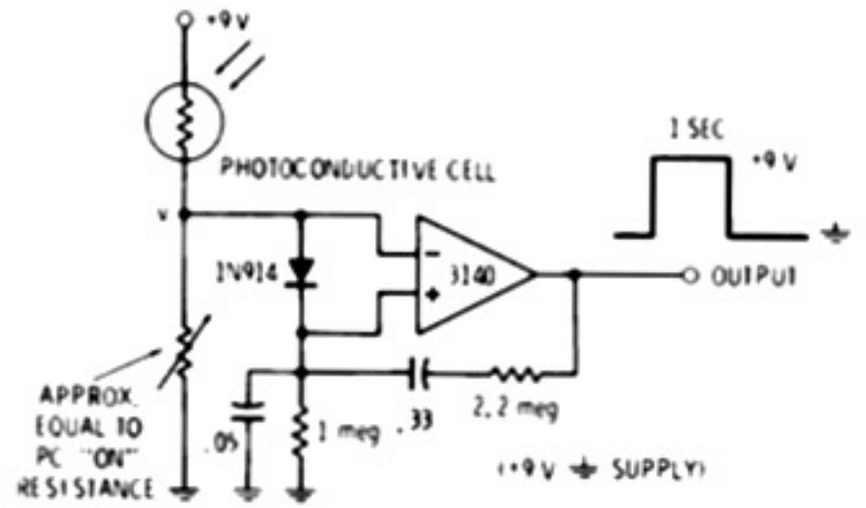
Getting a photoconductive cell to work properly in the real world can be a hassle, particularly for outdoor races and other sporting events. The resistance of the photocell may change with temperature, alignment, ambient light, and the cleanliness and length of the optical path. You can get spurious outputs, for instance, when a second pair of wheels on a racecar retrips the beam. And, unless your sensor circuit always slices the light/no-light conditions right down the middle, you can miss an event or lock up the output.

The simple 3140 op-amp circuit of Fig. 7-7 overcomes most of these hassles. It is a comparator circuit with a difference. In fact, it responds only to sudden changes due to interruption of the light, and ignores slow changes and the exact value of the photoconductor's *on* resistance.

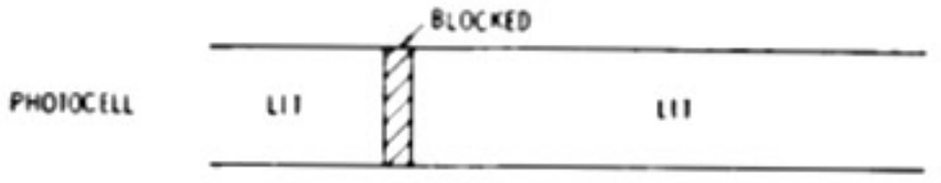
In normal operation, the voltage at point v is set to about one half the supply voltage while the cell is receiving normal, unbroken beam illumination. The diode between the inputs guarantees that the (+) input will be more negative than the (−) input, and the op amp will normally be at output ground, since it is connected as a simple comparator.

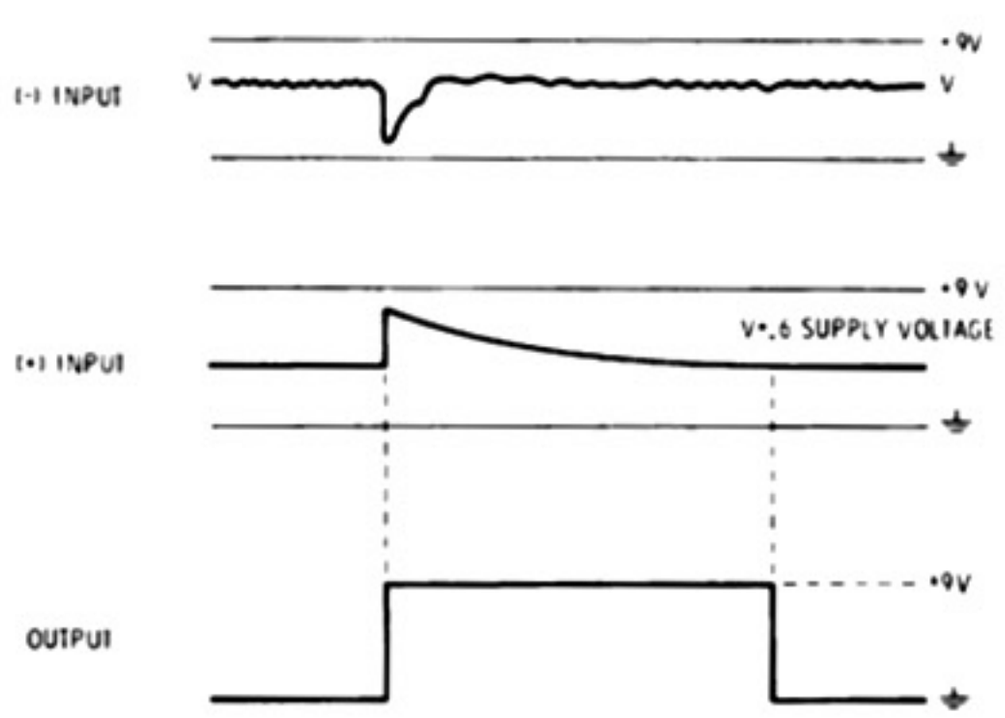
Now, if the beam is *suddenly* broken, the (−) input drops below the (+) input, and the output swings positive. The output *stays* positive for a delay time set by the recharging of the capacitor on the (+) input. This locks out all spurious signals until the photocell has a chance to reset itself to normal illumination. A time-out of a second or so is a good choice for power boats and racecars. During the lockout time, any new signals are ignored by the circuit. You get a clean, conditioned, output pulse.

If the photocell resistance changes slowly, the (+) input tracks it with varying ambient light, interference, temperature, and so on, without tripping. Voltage v can move over a large range as long as it does so slowly. Any sudden drop in voltage at point v produces an output.



(A) Circuit.





(B) Waveforms.

Fig. 7-7. Photocell amplifier/detector offers snap action, high noise immunity, and automatic tracking of ambient light levels.