Red LEDs function as light sensors

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Ordinary red LEDs normally function as light emitters, but they can also function as photosensors. A single LED can even function as both a light emitter and a light detector in the same circuit (**Reference 1**). The basic idea is to pulse the LED, using the on-time to light it and the off-time to sense the photovoltaic current from the ambient light that the LED sees.

Figure 1's circuit functions as a night-light. The LED stays off during daylight and turns on when the ambient-light level drops. The 7555 CMOS timer is a monostable one-shot, which triggers when Pin 2's voltage is less than one-third of the supply voltage. R_1 and R_2 form a voltage divider, which keeps the cathode of the LED just below the trigger voltage. When the ambient-light level is sufficient, the LED develops several hundred millivolts, which add to the R_1/R_2-junction voltage and keep Pin 2 above the one-third-trigger level. In this state, the Pin 3 output of the 7555 approaches 0V, and the 1N914 diode becomes reverse-biased, allowing the LED's photovoltaic current to flow into Pin 2's trigger input.

When the ambient-light level drops low enough, the LED voltage falls, and Pin 2 goes below the trigger level. The 7555 then generates a one-shot pulse, the 1N914 becomes forward-biased, and the LED lights up. At the end of the timing period, which R_3 and C_1 set, the monostable resets and discharges C_1. The monostable is then ready for another cycle. The LED then briefly turns off during this interval, which allows it to again sense the ambient light.

The circuit in **Figure 2** functions as a day-light; the LED flashes in bright light and stays off in low ambient light. The 7555 provides astable operation and slowly flashes the LED through the 1N914 diode as long as Pin 4's reset input is greater than approximately 600 mV. If the ambient light is too low, the LED cannot generate enough voltage at Pin 4, and the 7555 output remains near 0V, preventing the LED from turning on. The LED operates as a light emitter when Pin 3's output is high and as a sensor when Pin 3's out-
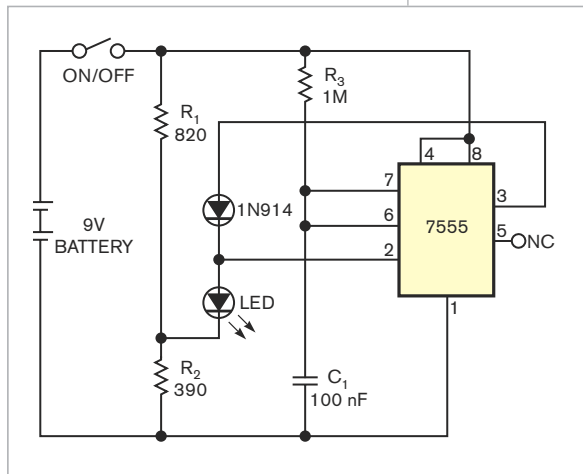

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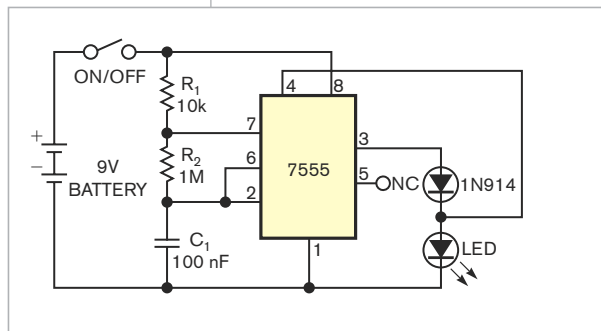

Figure 2 The LED in this circuit flashes slowly when the ambient-light level is high and turns off when the light level drops.

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put is low.

These circuits require no current-limiting resistor. The timer IC must be a CMOS type because, to operate correctly, the circuit design requires low input currents. The prototypes use Intersil's (www.intersil.com) ICM7555 devices.**EDN**

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