


## Simple single-cell white-LED driver uses improvised transformer

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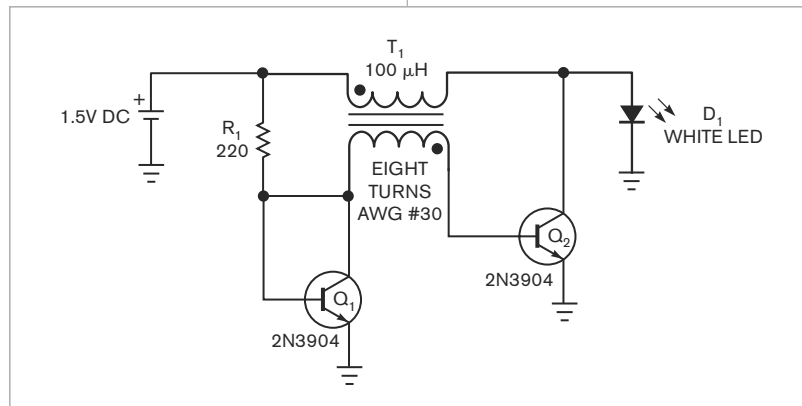
 A white LED delivers a wide color spectrum and better visibility than do monochromatic LEDs. However, a white LED presents a higher forward-voltage drop than do its colorful counterparts and thus poses problems for operation from a single 1.5V cell. The self-oscillating step-up converter in **Figure 1** features a minimal

component count and an easily assembled transformer,  $T_1$ .

During the time it takes to charge  $T_1$ 's primary inductance, resistor  $R_1$  and  $T_1$ 's added secondary winding provide sufficient base current to turn on  $Q_2$ .  $Q_2$ 's collector current increases until its base current can no longer hold the transistor in saturation. When  $Q_2$  comes out

of saturation,  $T_1$ 's magnetic flux and secondary-voltage polarity reverse. During  $T_1$ 's primary-discharge interval, the combination of  $T_1$ 's secondary voltage in series with  $Q_1$ 's base-emitter voltage applies reverse bias to  $Q_2$ 's base and turns off the transistor. When  $Q_2$  turns off, the voltage across  $T_1$ 's primary inductance adds to the battery voltage and applies a forward bias to the LED,  $D_1$ . The current through  $R_1$  determines the power applied to the LED and applies forward bias to  $Q_1$ 's base-emitter junction to provide temperature-compensated bias voltage for  $Q_2$ .

The breadboarded circuit's transformer,  $T_1$ , comprises eight turns of AWG #30 insulated wire wound around the body of an unshielded 100- $\mu$ H axial-lead inductor, producing approximately 400 mV p-p across the secondary winding. (**Editor's note:** Observe the winding's polarity dots. If the circuit fails to oscillate, reverse the connections to either the primary or the secondary winding.) The circuit operates over an input voltage range from just above  $Q_1$ 's base-emitter voltage drop of approximately 0.6V to the LED's forward-voltage drop of approximately 3V. The circuit's switching frequency exceeds 340 kHz at 1.5V input. **EDN**



**Figure 1** Two transistors and an easily assembled transformer drive a white LED from a single 1.5V battery.