

# Shunt regulator monitors battery voltage

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**▶** A TL431 shunt regulator is a perfect choice for many applications. You can use it as a comparator with hysteresis by taking advantage of its internal voltage reference along with few additional components. You can use this comparator with hysteresis, like a Schmitt trigger, as a simple battery monitor (Figure 1). You calculate the threshold voltage,  $V_{T+}$ , of this comparator as  $V_{T+} = V_{REF} \times (1 + R_1/R_3)$ , where  $V_{REF}$  the internal

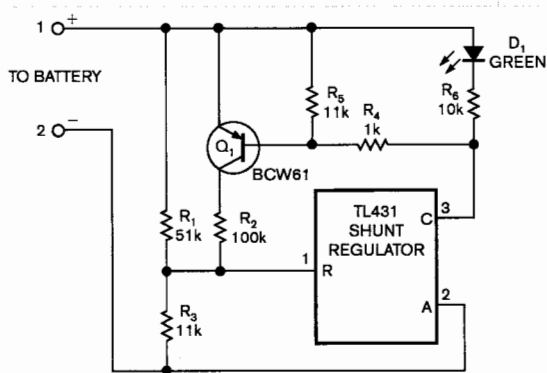


Figure 1 A shunt regulator and associated circuitry function as a Schmitt trigger, lighting LED<sub>1</sub> when the battery is fully charged.

reference voltage of shunt-regulator TL431, is 2.5V.

When the battery voltage is higher than the threshold voltage, the cathode voltage of the TL431 is at its low level of approximately 2V, and transistor Q<sub>1</sub> turns on, lighting LED<sub>1</sub>. You calculate the release voltage,  $V_{T-}$ , of the trigger as  $V_{T-} = V_{REF} \times (1 + R_1 \times R_2 / (R_1 + R_2) \times 1/R_3)$ .

When the battery voltage is less than the release voltage, the cathode voltage of the TL431 goes to its high level—to the battery voltage. Transistor Q<sub>1</sub> turns off, and LED<sub>1</sub> does not shine. LED<sub>1</sub> turns on again when the battery voltage, after recharging, exceeds the threshold voltage. EDN