Circuits provide 4- to 20-mA PWM control

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The circuits in **Figures 1** and **3** are useful when you use 4- to 20-mA current-loop signals to control a PWM signal. In both circuits, the minimum pulse width (corresponding to a 4-mA loop current) and the maximum pulse width (corresponding to a 20-mA loop current) are independently adjustable in the dedicated application with the use of one reference voltage. Furthermore, the circuits shut down the PWM output signal in case of a loop break. Both circuits are low-cost; you can use any op amp that provides an adequate slew rate to handle the desired PWM frequency.

The PWM circuit in **Figure 1** uses free-running oscillation. Amplifier IC_1 is a noninverting integrator that forces a constant current, I_C, into C_1, thus providing a constant linear slope on its output, V_{PWM}. When the divided fraction of V_{PWM} reaches the level of V_C on the negative input of comparator IC_3, the comparator's output switches high. Hence, FET Q_2 short-circuits divider resistor R_5,

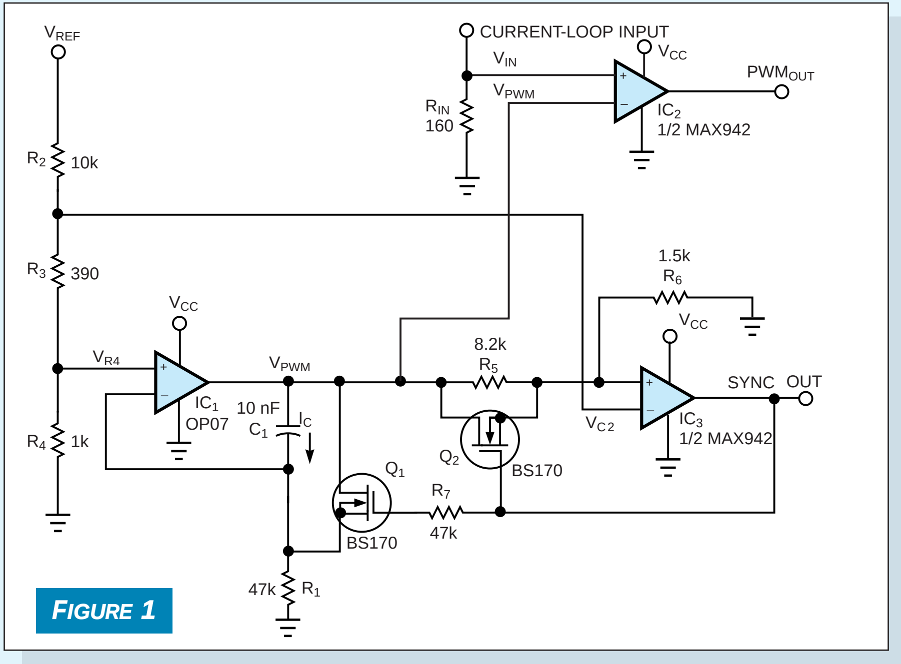


FIGURE 1

A free-running oscillator powers a current-loop controller for PWM signals. Duty cycle varies from 0 to 80% over the full-scale current range.

circuit in **Figure 1** to the Sync input of the circuit in **Figure 3**, you can omit R_2, R_5, and C_2. The following formulas apply to **Figure 1**:

$$V_{R4} = V_{REF}\frac{R_4}{R_2 + R_3 + R_4}.$$

$$V_{PWM(MIN)} = V_{R4}\frac{R_5 + R_6}{R_6}.$$

$$I_C = \frac{V_{R4}}{R_1}.$$

$$V_{C-} = V_{REF}\frac{R_3 + R_4}{R_2 + R_3 + R_4}.$$

$$V_{PWM(MAX)} = V_{C-}\frac{R_5 + R_6}{R_6}.$$

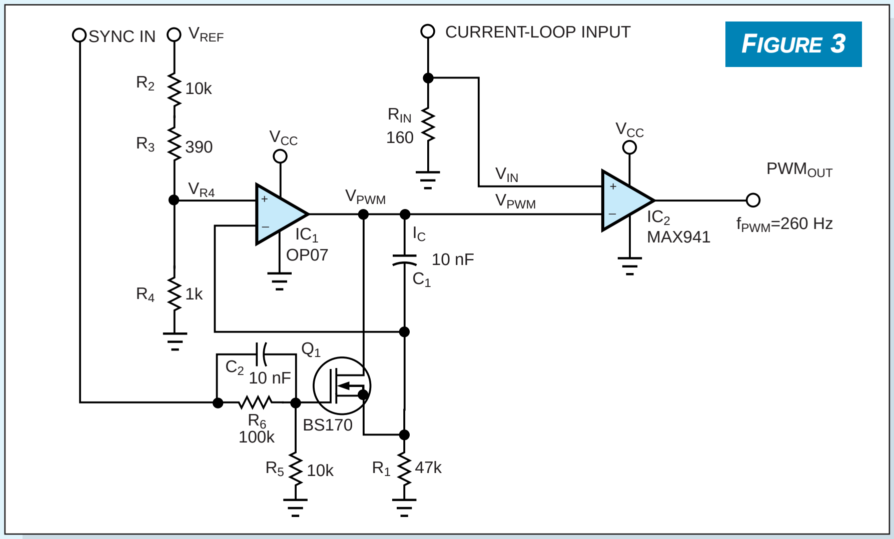
$$f_{PWM} = \frac{I_C}{C_1(V_{PWM(MAX)} - V_{PWM(MIN)})}.$$

These equations apply to **Figure 3**:

$$V_{R4} = V_{REF}\frac{R_4}{R_2 + R_3 + R_4}.$$

$$V_{PWM(MIN)} = V_{R4}\frac{R_5 + R_6}{R_6}.$$

FIGURE 3



The circuit in Figure 1 provides a linear duty-cycle-versus-current function. V_{PWM}, a function of the current, determines the duty cycle.

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$$I_C = \frac{V_{R4}}{R_1}.$$

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Circuit uses simple LED for near-IR light

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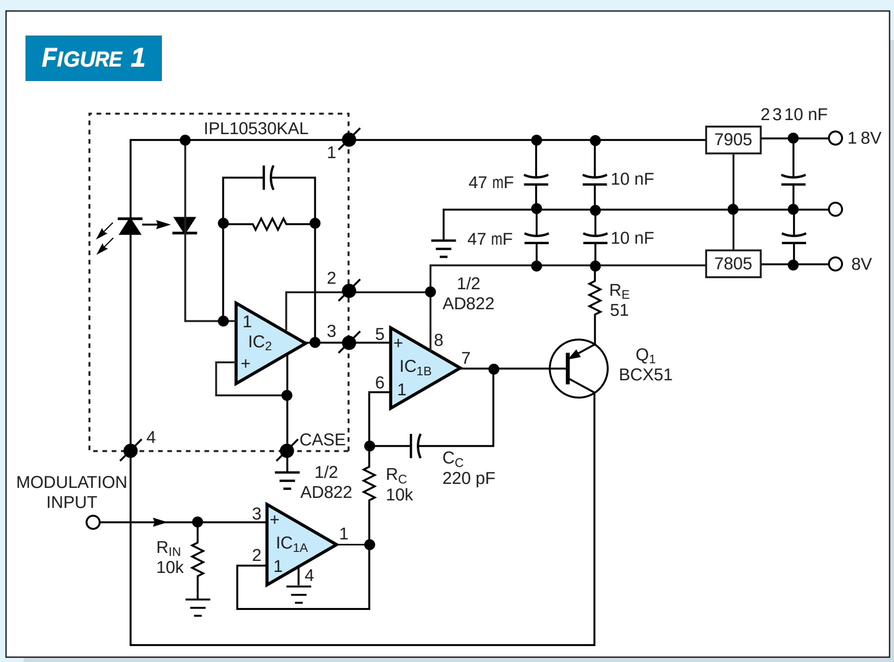
You can successfully use LEDs as sources of near-infrared light. However, when you need a source of light with precisely controlled power, a feedback loop is necessary to compensate for the temporal and thermal changes of the LED parameters. Standard LED types come with neither these monitoring detectors nor an external monitoring photodiode to detect part of the emitted light and generate a feedback signal. The situation calls for some mechanical fixture to mount the photodiode. Such a solution, however, is bulky and cumbersome, especially when space is scarce. You can solve the problem by using an 880-nm IPL10530KAL hybrid detector/emitter module from Integrated Photomatrix Ltd. A modulated IR light source uses only one dual op amp, a transistor, and two voltage regulators (**Figure 1**).

The modulation input acts as a reference voltage and connects via amplifier IC_{1A} to the comparing feedback-loop

FIGURE 1



A few inexpensive components connected to a detector/emitter module enable you to obtain precise control of near-IR emitted light.