# Circuit uses simple LED for near-IR light

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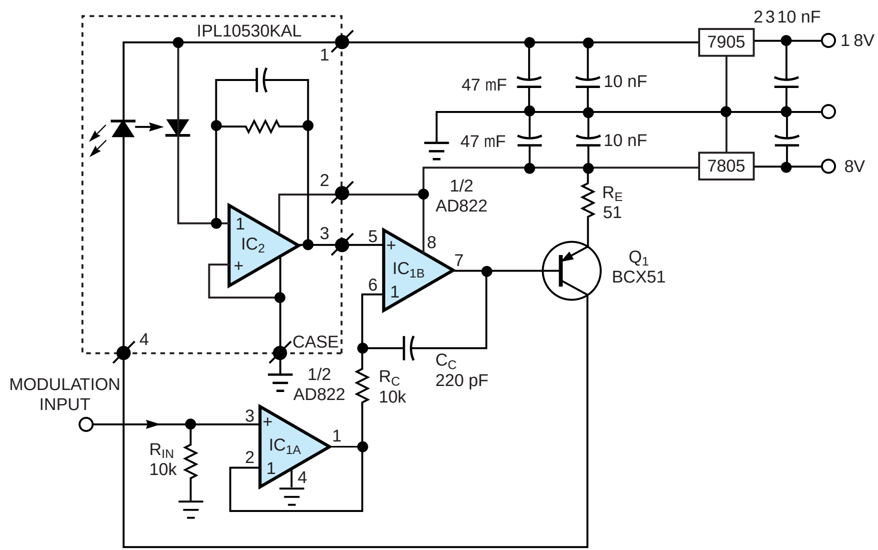
You can successfully use LEDs as sources of near-infrared light. However, when you need a source of light with precisely controlled power, a feedback loop is necessary to compensate for the temporal and thermal changes of the LED parameters. Standard LED types come with neither these monitoring detectors 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**

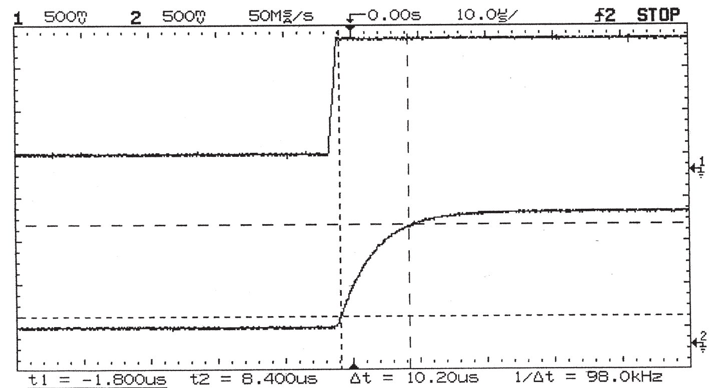



A few inexpensive components connected to a detector/emitter module enable you to obtain precise control of near-IR emitted light.

amplifier, $IC_{1B}$. The resulting output voltage drives the output transistor, $Q_1$, which directly drives the LED. Resistor $R_E$ limits the maximum drive current to approximately 80 mA, thus preventing damage to the LED. You can reduce $R_E$'s value if you need higher power levels; the absolute maximum rating for the LED is 500 mA. If you change $R_E$, you may need to alter the frequency-compensation network. The network comprises $R_C$ and $C_C$ and introduces a pole at 0 Hz and a zero at $1/2pR_CC_C$ into the open-loop transfer function. The zero cancels the pole (at approximately 100 kHz) that the monitoring-photodiode preamplifier introduces, so the pole is a dominant pole in the feedback loop.

With the component values shown, the 3-dB modulation bandwidth of the source is approximately 40 kHz. You can experimentally determine the value of the compensating capacitor, $C_C$ by observing the voltage at Pin 3 of $IC_2$ and driving the circuit with a square wave (**Figure 2**). The output is a filtered version of the optical-output waveform. A Spice simulation shows the phase margin to be approximately 858. The AD822 dual rail-to-rail op amp accommodates modulation-input voltage from 0 to 5V. The slope efficiency of the entire source (defined as $dP_1/dV_{MOD}$) is approximately 1.5 mW/V and may vary slightly from unit to unit of detector/emitter modules.

**FIGURE 2**




$IC_2$ in Figure 1 delivers a clean response to a modulation-input step function.

You can use this design as an IR light source in a precise reflectrometric measurement system incorporating pulse modulation and synchronous detection. To increase accuracy of the system comprising the entire optical head, you can install the system in a thermally stabilized environment with temperature controlled to within 0.58C. The long-term measured power stability of the source is better than 1 ppm after initial warm-up. (DI #2243)

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