PROJECT OF THE MONTH

BY FORREST M. MIMS

HIGH-CURRENT LED PULSER

INFRARED LEDs make ideal optical sources for remote controls, intrusion alarms, reflective and break-beam object sensors, signaling devices and TV commercial killers. However, unless an efficient heat sink is employed, most infrared LEDs are restricted to a maximum continuous forward current of no more than 100 milliamperes. At this current, a high-quality GaAs:Si LED will deliver from 6 to 10 milliwatts of optical power. This is roughly equivalent to the *visible* radiation emitted by a small one- or two-cell penlight with a prefocused lamp.

Rapidly pulsing a LED at very high current levels makes it possible to obtain much higher power outputs. For example, a G.E. 1N6264 LED that emits 6 mW at 100 mA of forward current will emit 60 mW when driven by 1-ampere pulses a few microseconds wide.

Figure 1 shows a simple circuit that can deliver high current pulses to an LED. This pulser is considerably more powerful than the LED transmitter module that was the Project of the Month for February 1979. With the parts values shown, it will apply hefty 2.7-ampere pulses at a rate of about 100 Hz to a LED. The pulses are about 17 microseconds wide. They can be readily detected by a simple phototransistor receiver such as the Project of the Month for January 1979. Current drain from a small TR175, 7-volt mercury battery is 5 mA.

Many different LEDs can be used with the pulser. For most LEDs, the peak current exceeds by a factor of three the component's maximum continuous rating. Applying even larger pulses will not necessarily destroy a LED, but might shorten its useful life. For best results, use infrared emitters made from GaAs:Si rather than GaAs diodes. Good choices include the TIL-32 (Texas Instruments), 1N6264 (General Electric), OP-190 and OP-195 (Optron) and 276-142 (Radio Shack).

You might have difficulty finding the transistors specified in Fig. 1. If so, you can substitute a common npn silicon device such as the 2N3904 or 2N2222 for *Q1*. The choice of *Q2* is more critical, however. If maximum current is to be delivered to the LED, *Q2* must be a *germanium* transistor. A germanium pn junction has a smaller forward voltage drop than a silicon pn junction, and this causes a germanium transistor to have a lower effective "on" resistance. The LED therefore receives more current if a germanium device is used.

The 2N1132 works better than any other germanium transistor I've tried. The 2N1305 is easier to find and will deliver about 2 amperes to the LED. If you can't find a suitable germanium transistor you can substitute a common pnp silicon switching transistor such as the 2N3906 or 2N2907. Less current will be delivered to the LED, but the optical output will still be adequate for many applications.

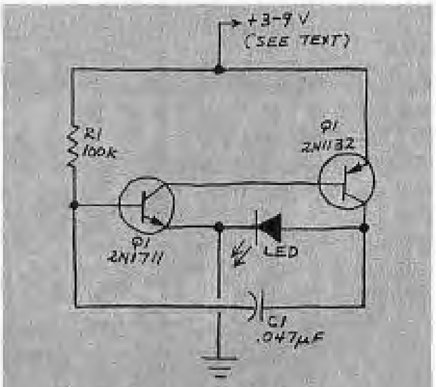

Fig. 1. High-current LED pulser.

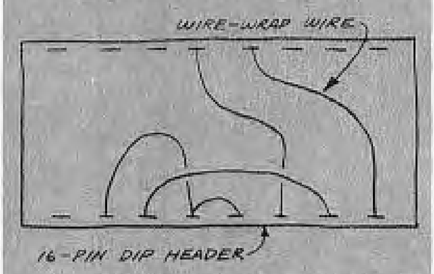

Fig. 2. Connections for LED pulser.

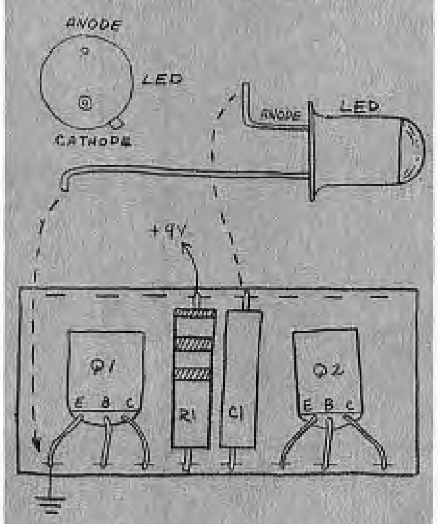

Fig. 3. Pulser component placement.

For example, if *Q1* is a 2N3904, *Q2* is a 2N3906 and the circuit is powered by a standard 9-volt battery, 1.1-ampere pulses will be delivered to a LED. Because of the different characteristics of the silicon transistors, the repetition rate will jump to 1400 and the current demand will increase to about 100 mA. That's enough to quickly deplete even an alkaline battery, so for best results the resistance of *R1* should be increased to reduce the pulse-repetition rate and the operating current. For example, if the value of *R1* is changed to 1 megohm, the repetition rate will decrease to 120 Hz and the current drain to a much more reasonable 8 mA.

Once you've made a final selection of component types and values, you can assemble a permanent version of the LED pulser on a DIP header or postage-stamp-sized perforated board. I took the latter approach for my germanium-transistor unit because the transistors are packaged in TO-5 cans. It was still possible to install the pulser, TR-175 battery, switch and adjustable lens in a brass tube measuring 0.5" × 3.25" (1.3 cm × 8.3 cm).

Figure 2 shows how to assemble the pulser on a DIP header if silicon transistors in plastic packages are used. Interconnect the pins on the header with Wire-Wrap leads, but don't solder them in place yet. Use lengths of wire that are longer than necessary, securing them in place by wrapping their free ends under the header.

Figure 3 shows where the components go. To make things as compact as possible, use a miniature tubular capacitor for *C1* instead of a ceramic disc. Any capacitance from 0.01 μF to 0.05 μF is satisfactory, but the smaller values will increase the pulse-repetition rate and reduce the current to the LED somewhat. If you must use a disc for *C1*, try bending it over the top of the header so that it will present a lower profile and leave room for the LED.

If you use a miniature tubular capacitor for *C1*, the completed circuit will use only half the space in the DIP header's cover. Instead of installing the cover, I clipped all the pins from the header and mounted it on a snap terminal salvaged from a discarded 9-volt battery. The conductive strips at each terminal were trimmed to size and folded over each end of the header to secure it in place. Taking care to observe the polarity, I soldered short connection wires from the header to the two metal strips. The result is a tiny but powerful LED transmitter that snaps directly onto the terminals of a 9-volt battery.

Whether you use germanium or silicon transistors, with a little care you can install the complete pulser in a pen-light, lipstick tube, pill bottle or other small container. Although the germanium unit is more powerful, even the silicon pulser projects a beam that can be received at 1000 feet or more at night using a simple phototransistor receiver—provided you use a 2- or 3-inch lens at each end of the link. ◇