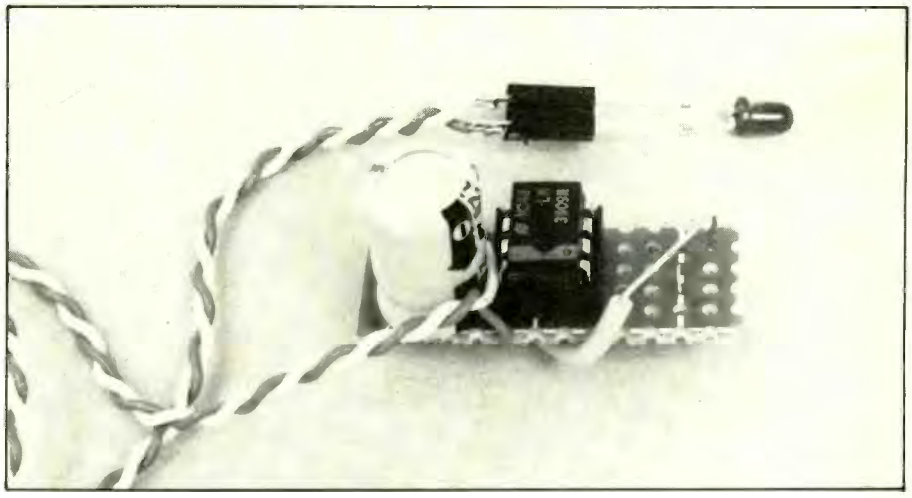
A Miniature LED Beacon

This easy-to-build project adds more realism to model airplanes, trains, etc., and can be used as an attention-getting device in jewelry and science-fair projects

By Dan Becker



If you operate model railroads, airplanes, etc., the battery-powered Miniature LED Beacon to be described can enhance their realism by providing a railroad warning light or an airplane or rocket strobe or landing light. Alternatively, the tiny circuit can be used to draw attention to signs or, with a wristwatch battery, to create electronic jewelry. The project is small and light enough in weight to fit inside or on any model. It uses only few low-cost components and can be assembled in an hour or less. In fact, if you are an experienced electronics experimenter or hobbyist, chances are good that you have all the components needed in your spare-parts box.

About the Circuit

The Miniature LED Beacon circuit is shown schematically in Fig. 1, which also illustrates the internal workings of the LM3909 integrated circuit that makes up the heart of the project. In this circuit, *IC1* performs as both a LED driver and an oscillator. The circuit is powered by a No. 357A 1.5-volt cell. Because circuit current drain is less than 1 milliampere, this cell will provide more than seven days of continuous operation.

Current flows from the positive (+) terminal of *B1* via pin 5 of *IC1* through internal resistors *RA* and *RB* and to the IC's pin 2 output. This current charges capacitor *C1* and flows through the *RC/RD* series resistor combination. Resistors *RA* through *RD* and capacitor *C1* make up an RC timing circuit whose time constant (charging time) is 2.16 seconds.

When the charge on *C1* reaches about 1.5 volts, the comparator inside *IC1* switches on. This, in turn, switches on transistor *Q1*.

Once *Q1* switches on, it provides a low-resistance current path in which the voltages across *B1*, *RE* and *Q1* are in series with each other. The advantage of this arrangement is that the 1.5 volts across *B1* and the nearly 1.5 volts of charge on *C1* add to put a 3-volt potential across *LED1*.

The discharge time constant is about 6 milliseconds. This yields a short, bright flash of light from *LED1*. When *LED1* flashes, it discharges *C1* so that the cycle can repeat. This charge/discharge cycle repeats once every couple of seconds.

Construction

The circuit can be assembled on a ½ × 1⅜-inch perforated board that has holes in 0.1-inch centers. For soldering convenience, each hole should be surrounded by a narrow circle of copper cladding on one side only.

Position the board as shown in Fig. 2, and install an 8-pin DIP IC socket ½ inch from the left end, with pin 1 positioned nearest the lower-right corner of the board. Solder the socket's pins to the copper circles on the board.

Plug electrolytic capacitor *C1* into the holes in the board, route its positive (+) lead to pin 2 of the socket and solder the connection. Clip off any excess capacitor lead length. Similarly, route the capacitor's negative (−) lead to pin 8 of the IC socket, solder the connection and clip off any excess lead length. Incidentally, to keep the circuit assembly as compact as possible, use a capacitor with a 6.3-volt rating. Of course, if you cannot find a 6.3-volt electrolytic,

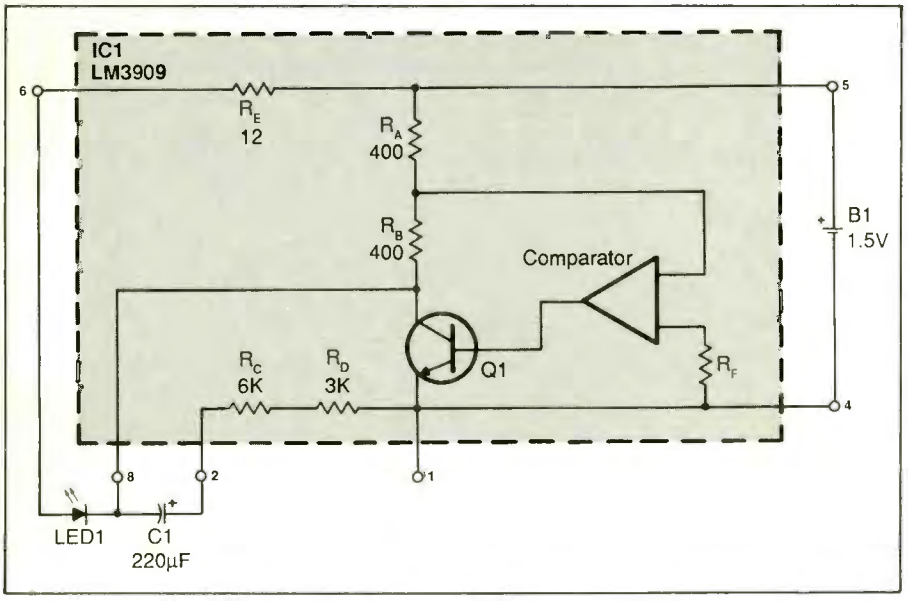


Fig. 1. Schematic diagram of Miniature LED Beacon.

PARTS LIST

B1—No. 357A battery (Radio Shack Cat. No. 23-115 or similar)—see text

C1—220-µF, 6.3- or 16-volt electrolytic capacitor with radial leads (see text)

IC1—LM3909 LED flasher/oscillator (Radio Shack Cat. No. 276-1705)

LED1—Any general-purpose red light-emitting diode.

Misc.—Perforated board with holes on 0.1-inch centers and thin solder rings around each hole (Radio Shack Cat. No. 276-185 or similar) 8-pin DIP socket for IC1; 2-conductor, light duty cable or individual 26-gauge stranded hookup wire (see text); 24-gauge solid hookup wire; insulating plastic tubing; solder; etc.

you can use one that has a 16-volt rating at the penalty of larger assembly size.

When you install *C1*, position it so that its negative lead is as close as possible to pin 8 of the socket. Before routing and connecting the positive lead to the socket, slip over this lead a ⅜-inch length of insulating plastic tubing and then route it to pin 2 of the socket.

A standard red light-emitting diode (*LED1*) connects to the circuit assembly via its cathode lead to pin 8 and anode lead to pin 6 of the IC socket via an appropriate length of two-conductor cable or two separate stranded hookup wires loosely twisted together.

To prepare the cable or wires, start by removing ⅛ inch of insulation from both conductors at both ends. Then tightly twist together the fine wires in each conductor and sparingly tin with solder.

Separate the conductors at one end of the cable about 1½ inches and then slip over each the 1-inch length of insulating plastic tubing. Clip the cathode lead of the LED to ½ inch and solder to it one of the cable conductors. Similarly, clip the LED's anode lead to ½ inch and solder to it the other conductor. Then slide the plastic tubing over the soldered connections until it contacts the bottom of the LED's case.

Connect and solder the other end of the cable to the appropriate pins of the IC socket. Make sure that the cathode conductor goes to pin 8 and the anode lead goes to pin 6.

To mount *B1* on the board, you need some sort of holder, which you can make from a ¾-inch length of 24-gauge solid tinned hookup wire from which all insulation has been removed. Bend the wire to form a "U" shape whose "legs" are parallel to each other and 0.1 inch apart. Plug the legs of the wire U into the holes at the center of the battery area in the perforated board.

Locate the center of the battery area as follows. First, set the No. 357A cell with its negative lead facing toward the board and immediately to the right of the socket. Then use a pencil to lightly trace the outline of the cell onto the board's surface. Remove and set aside the cell and count the number of holes across the outline to find the center. Plug the wire U into the holes that most approximate the center location. Bend one leg of the wire U flat against the board, route it to pin 4 of the IC socket and solder the connection. Bend the other leg flat against the board in the opposite direction and solder it to any convenient point on the board.

Press the part of the U that protrudes from the top of the board flat against the surface so that the cell sits as close as possible on the board.

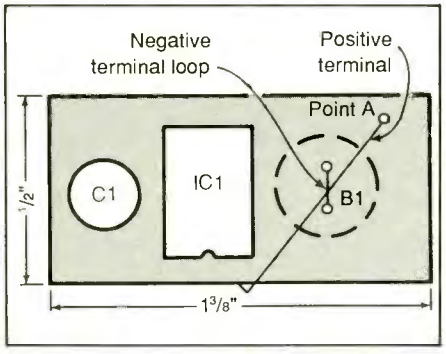


Fig. 2. Assembly details for project, which mounts on and is wired to a small perforated board.

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For the positive battery terminal, strip ⅛ and ¾ inch of insulation from opposite ends of a 1¾-inch length of No. 26 solid hookup wire. Plug the end from which the ¾ inch of insulation has been removed into the board from top to bottom and solder it at point A, as shown in Fig. 2. Now position the No. 357A cell, positive electrode up, against the IC socket and hold it in place as you bend the wire over the top of the cell and around the outer edge of the board. Route the wire and solder it to pin 5 of the IC socket. The hookup wire should solidly "sandwich" the cell in place but still permit easy removal of the cell. ME