A Bicycle Safety Flasher

An attention-getting flasher/turn-signal indicator that motorists can see a long way off

By TJ Byers

Bicycling is a pleasant and rewarding form of physical exercise, enjoyed by millions of people around the world. Unfortunately, sharing the road with cars and other motor vehicles exposes cyclists to traffic accidents simply because motor vehicles operators often fail to see them at night until it is too late.

Safety reflectors and standard lights have limited effectiveness. A more effective solution is to equip your bicycle with an attention-getting light of its own, which is where the Bicycle Safety Flasher project described in this article comes in.

Using an eye-catching scanning technique, the device creates a moving display similar to many road-hazard lights. The moving lights instantly get the attention of any motorist. And adding to the project's safety features is a convenient switch that lets you signal when you want to make a turn.

How it Works

Shown in Fig. 1 is the schematic diagram of the basic Bicycle Safety Flasher. The circuit uses CMOS digital ICs. Type-D flip-flop *IC1* is operated as a free-running astable multivibrator. The complementary outputs of this IC are cross-coupled to the SET (S) and RESET (R) inputs through *R1* and *R2* to set up a feedback loop that toggles the flip-flop from one state to the other to generate a square-wave output signal. An RC timing circuit made up of *C1, C2, R1* and *R2* determines the output frequency of the multivibrator.

Programmable counter/divider *IC2*'s 10 outputs go high one at a time in sequence with the pulse count delivered to its CLOCK input from *IC1*. Each time *IC1* outputs a pulse, it increments the count of *IC2* by one. The RESET input of *IC2* allows an output pulse to reset the counter at the end of a predetermined count. The Bicycle Safety Flasher, for example, counts up to only five before output 6 resets the circuit and forces the count to start over again.

Four transistors that sequentially light four incandescent light bulbs are driven by the outputs of *IC2* in a manner commonly referred to as a "lamp chaser" because of its characteristic "moving-bulb" motion. To eliminate the jerkiness associated with so many lamp-chaser circuits, *IC2*'s outputs are ORed together so that two lamps are always lit at the same time.

Output 1 at pin 2 of *IC2* is connected to *D2* and *D3* that drive *Q3* and *Q4*, respectively. The diodes are arranged in a logic-OR configuration so that when pin 2 is high, both *Q3* and

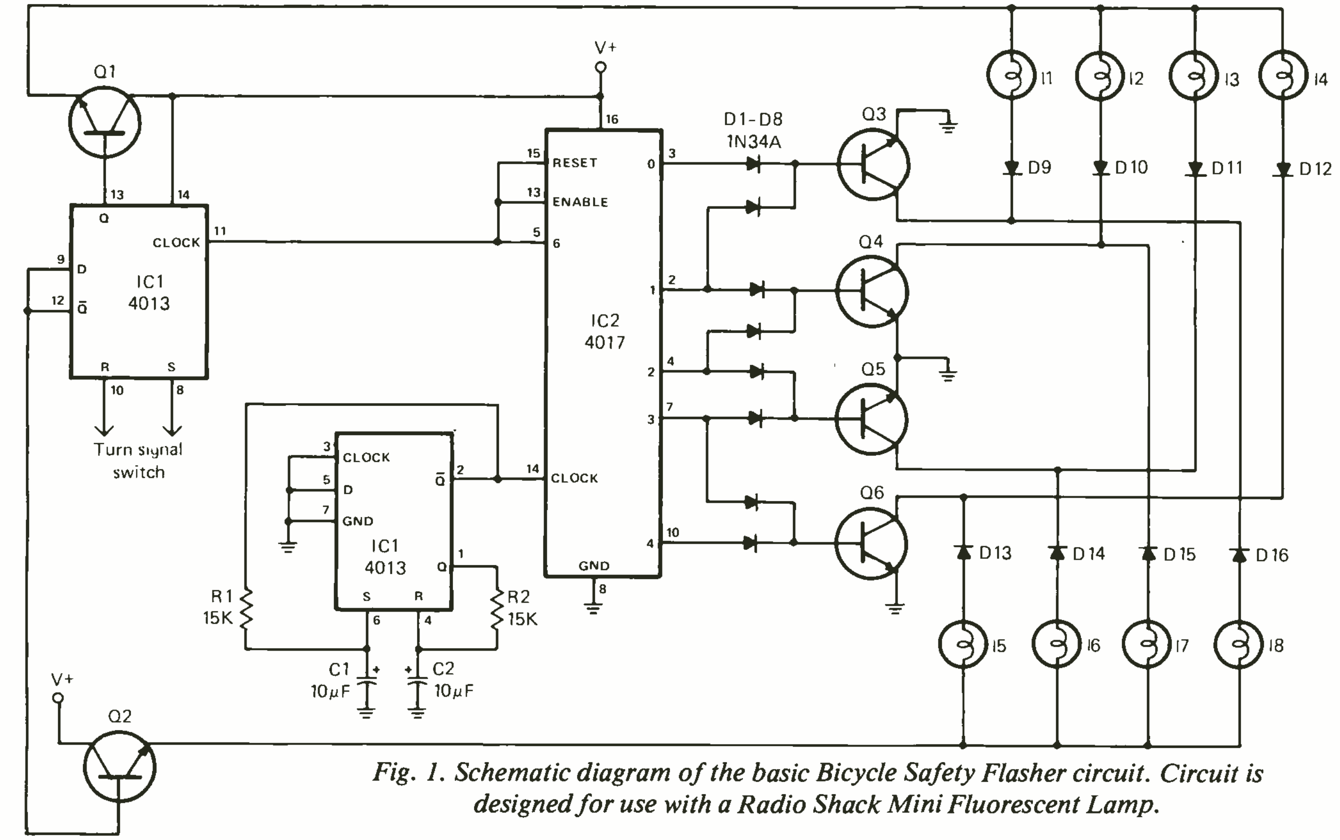

Fig. 1. Schematic diagram of the basic Bicycle Safety Flasher circuit. Circuit is designed for use with a Radio Shack Mini Fluorescent Lamp.

PARTS LIST

Semiconductors

D1 thru D16—1N34A or similar small-signal germanium diode (do not substitute; see text)

LED1—Blinking light-emitting diode (Radio Shack Cat. No. 272-1139 or similar)

IC1—CD4013 dual type-D flip-flop

IC2—CD4017 decade counter/divider

Q1 thru Q6—2N3904 transistor

Capacitors

C1,C2—10-μF, 16-volt tantalum

Resistors

R1 thru R4—15,000 ohm, ¼-watt

Miscellaneous

S1—Spring-return, center-off dpdt switch

Printed-circuit board; Radio Shack Cat. No. 61-2734 Mini Fluorescent Lamp (or suitable plastic chassis box; see text); plastic box for turnsignal switch; electrician's U-clamps (2); four-conductor cable; machine hardware; solder; etc.

Note: The following are available from Danoconths, Inc., P.O. Box 261, Westland, MI 48185: Complete kit of parts, No. RW-127K (does not include plastic cases), for $30; etched and drilled pc board, No. RW-127, for $14.

Q4 are conducting and lighting *I1* and *I2*, respectively.

When the pulse input to CLOCK pin 3 of *IC2* advances the count to 2, the logic at *Q3* is no longer true, causing *I1* to go off. However, *Q4* still has a valid logic input from output 2 via *D4*, keeping *I2* lit. The advance in the pulse count also makes the logic to *Q5* true, in turn lighting *I3*. Hence, as *I1* goes off, *I3* lights and *I2* remains on. Likewise, another clock input forces *I2* to go off and *I4* to light, with no change in the status of *I3*.

The lamps are arranged so that the on/off cycles produce a sweep effect that is more brilliant because of the combined light from two lamps. It also provides a smoother transfer of motion from one station to the next. The lamps are divided into two rows, each powered from two different sources, controlled by *Q1* and *Q2*.

The power transistors are, in turn, controlled by a second flip-flop in *IC1*. When one transistor is on, the other is off, and vice-versa so that only one row of lights is activated at a time. Also note that the CLOCK input of this flip-flop is connected to the RESET pin of *IC2*. Hence, every time the counter is reset, *Q1* and *Q2* alternate states, such that when one is conducting the other is off.

Wiring the lamps so that one row chases in one direction and the other row chases in the opposite direction creates a flashing motion that sweeps back and forth to provide an instant attention-getting display.

It is a simple matter to add to the basic Bicycle Safety Flasher a sequential turn-signal feature. This is done by forcing the second flip-flop in *IC1* to keep either *Q1* or *Q2* conducting continuously while holding the other in cutoff, the selected position depending on which turn you want the lights to indicate.

Turn-signal indicator operation is as follows. If SET pin 8 of *IC1* is forced high, only *Q2* can conduct. The CLOCK input is effectively locked out and only *I5* can light. Similarly, forcing pin 10 to high locks out *Q2* and allows *Q1* to remain conducting.

In Fig. 2 is shown the switching arrangement for the turn-signal indicator feature. Flipping spring-return dpdt center-off switch *S1* to either of its "on" positions selects the appropriate turn indication. Letting go the toggle of the switch causes it to automatically return to its center-off position, restoring basic flasher operation.

Note in Fig. 2 that light-emitting diode *LED1* serves as an indicator that tells you when the turn-signal circuit has been selected. The LED flashes whenever *S1* is set to either of its "on" positions and is off when the switch is in its center-off position.

Power for the circuit is provided by a 4.5-volt dc source, with the positive side going to the V+ points in the circuit and the negative side going to circuit ground. There should be an spst slide or toggle switch in series with the + lead and the circuit so that power can be switched on and off. For the Fig. 2 circuit, *S1* is *in addition* to any on/off power switch used.

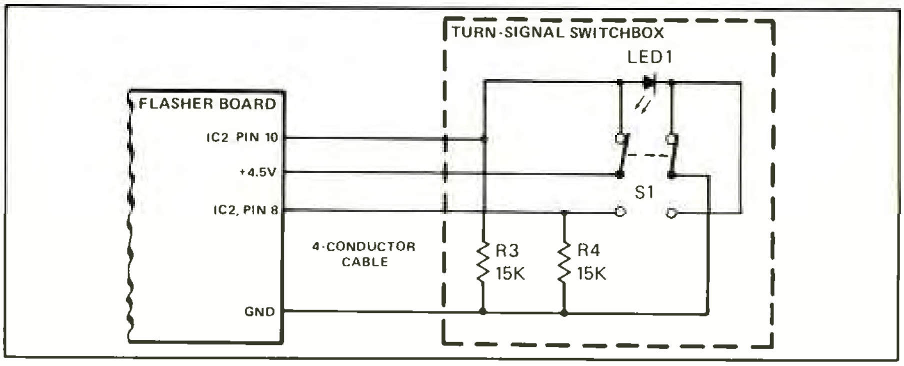

Fig. 2. The turn-signal switch with flashing light-emitting diode circuit.

Construction

A modified Radio Shack Mini Flourescent Lamp (see Parts List) was used for the Bicycle Safety Flasher shown in the lead photo. However, you can build the circuit into any case sized to accommodate a long, narrow printed-circuit board and three 1.5-volt C or D cells and a slide or toggle spst switch.

In Fig. 3 is shown the actual-size etching-and-drilling guide for the pc board. You can fabricate your own or purchase one ready for wiring from the source given in the Parts List. When you are ready to wire the board, begin with the diodes, making sure they are installed in the proper orientation per the component-placement diagram in Fig. 3. (Note that the Parts List calls for small-signal *germanium* diodes. Because the Flasher's power supply delivers less than 5 volts dc, it is important that you *do not substitute* silicon diodes here.)

Before installation, the base and emitter leads of *Q3* through *Q6* must be transposed to allow them to plug into the pc board's holes. (Leave the leads of *Q1* and *Q2* as they are.) To do this, hold the transistor with its flat facing toward you and the leads pointing down. Use longnose pliers to carefully bend the center (base) lead straight back flush with the botom of the case, and at the lip of the case, bend it straight down.

Similarly, bend the right-hand (collector) lead forward and slightly to the left so that it is flat against the bottom of the case and in line with—but not touching—the base lead, and then bend it straight down at the lip of the case. Bend these leads only once; otherwise, you may break off the leads, destroying the transistors.

When all four transistors are prepared, install them in their respective locations on the board, with the flats facing toward the lamp area. Then install *Q1* and *Q2*.

Space limitations on the circuit board require that the thin parts that normally go into the holes in the board of pins 6, 9, 11 and 12 of *IC2* be trimmed away. Before you cut, however, double-check the pin numbers! Then make sure you properly install both ICs in their respective locations. Do *not* use sockets. There is no room for them inside the project.

Install the resistors and capacitors, properly polarizing the latter. Clip the leads of all lamps to about 1" long, strip away about ¼" of insulation from each and install them on the board. Use one of the clipped lamp leads to jumper between pin 2 of *IC1* and pin 14 of *IC2*.

Arrange *I1* and *I5* side by side with one pointing toward the top and the other toward the bottom of the board; use plastic cement to secure them together. Repeat with the *I2/I6*, *I3/I7* and *I4/I8* pairs. Make sure that if *I1* is pointing up and is on the left, *I2*, *I3* and *I4* are oriented and positioned the same way.

Now refer to Fig. 4 and wire *S1* as shown. Install the resistors directly on the lugs of the switch, and do not forget the jumper wire. The drawing shows *LED1* mounted on *S1* only to give wiring information. Actually, *LED1* connects to the switch via short wires after the two are installed inside a plastic box, with the LED mounted in its own separate hole.

As you can see from the etching-and-drilling guide in Fig. 3, the Bicycle Safety Flasher was designed to fit inside the Radio Shack Mini Flourescent Lamp's case. Of course, if you wish, you can install it inside a dif-

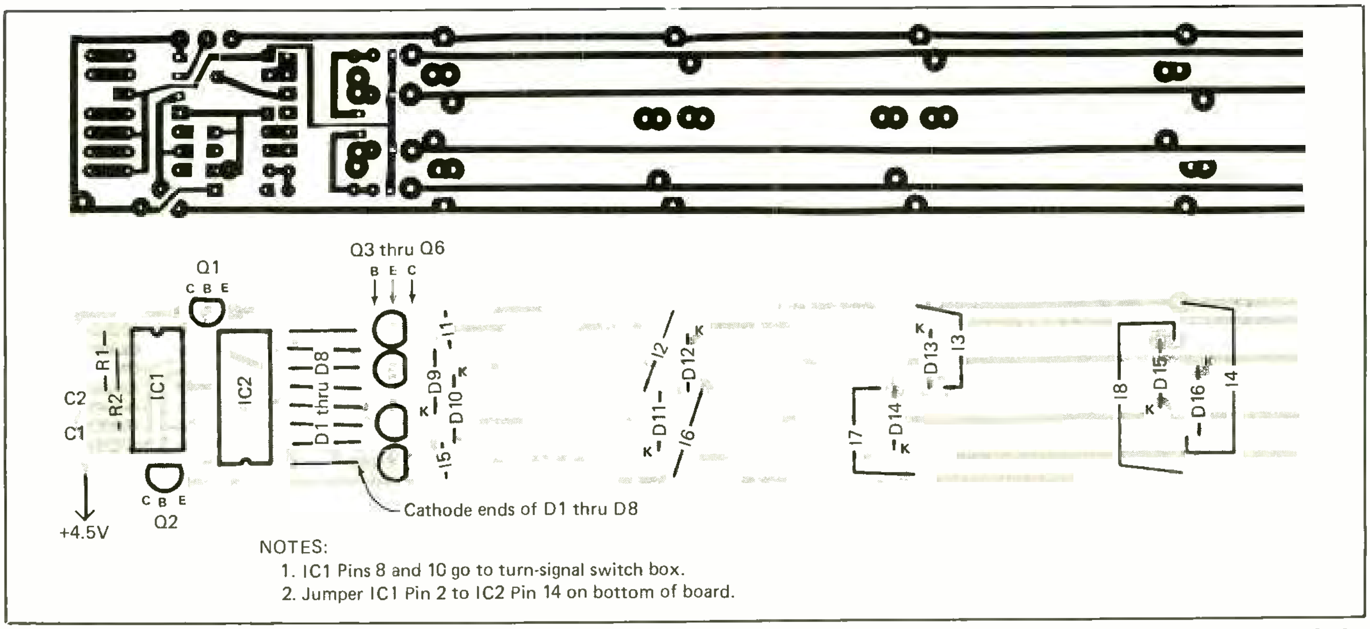

Fig. 3. Actual-size etching-and-drilling guide (upper) and components-placement/orientation diagram (lower). Note that to save real estate on the pc board, unused pins of IC2 are trimmed away before mounting the IC.

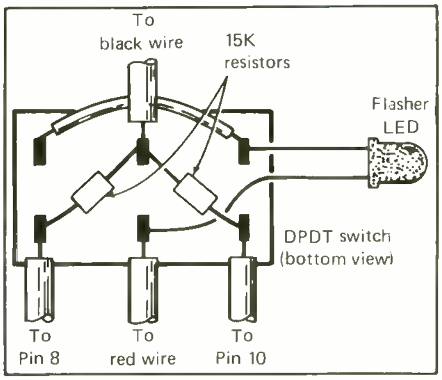

Fig. 4. Wiring details for turn-signal switch/LED arrangement. The LED actually mounts in a panel and is connected to the switch lugs via hookup wire. It is shown here connected directly to the lugs only for the purpose of showing proper polarity.

ferent case, as described above, but the Radio Shack lamp is ideal for this application.

Before you can install the circuit inside the lamp, you must modify the latter as follows. First, unscrew the end rings and slip off the black endpieces. Break down the lamp into four parts: clear lens, flashlight assembly, battery case and fluorescent tube. Remove the fluorescent tube and its electronic circuit board, including the yellow wire. Unsolder the black and red leads going to the board. Save the fluorescent tube and circuit board for some other low-voltage use.

Now use a hacksaw to cut away the black plastic lamp socket that separates the tube from the circuit board. Do *not* remove the opposite end barrier or its metal contact; they are needed for the battery holder. Finally, remove the metal reflector.

Solder the red and black wires coming from the lamp's battery supply to the indicated points on the flasher board (Fig. 3). Also solder two wires of a 4-conductor cable to pins 8 and 10 of *IC2* and the remaining two wires to the +4.5V and GND pads on the pc board. This cable goes to the turn-signal switch.

Drill a hole in the lamp case, tie a knot in the 4-conductor cable about 3″ from the end connected to the circuit board, and route the free end through the hole. Determine how long this cable must be from the lamp to the turn-indicator switch box and clip it to the length needed.

Mount *S1* and *LED1* in a plastic box large enough to accommodate them. Then mount an electrician's U-clamp on the cases of the lamp and the switch box. Make sure the screws do not touch the battery cells. Route the free end of the 4-conductor cable through a hole in the switch box. After preparing the end of the cable for soldering, tie a knot about 3″ from this end and wire the conductors, resistors and LED to the switch as shown in Fig. 4. Finally, install the battery in and reassemble the lamp.

Flip the lamp's power switch to the fluorescent position and observe the bulbs in the project; they should flash in the "chaser" format described above. Leave the power switch as is and flip the turns-signal switch to one "on" position and note that the lamps flash sequentially to indicate a turn in one direction. Then flip the switch to its alternate "on" position and note that the lamps sequentially flash in the other direction.

If you do not obtain the proper indications, set the power switch to "off" and check component installation, wiring and particularly solder-

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ing. Correct any problem before proceeding to installation.

Installation

After your Bicycle Safety Flasher checks out as operational, mount it and the turn-signal switch on your bicycle via the U-clamps. The lamp/Flasher assembly mounts on the seat post, the turn-signal switchbox on the handlebars.

To use the Bicycle Safety Flasher, slide the Mini Lamp's power switch to the fluorescent lamp position to obtain multi-lamp bar flasher operation. Note also that the lamp's built-in flashlight (which was not defeated in the modification detailed above) will be active when the switch is set to the flashlight position. If you opted for a housing other than the specified Mini Lamp, of course, the power switch will have only a single "on" position and no built-in flashlight.

Have fun . . . and safe cycling! **ME**