BUILD THIS

# ELECTRONIC XMAS TREE

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*This pocket-size electronic Christmas tree will give your holiday lighting a new and festive look.*

FOR ABOUT $10 YOU CAN BUILD A UNIQUE high-tech Christmas tree that will add a new and festive look to both your home and office holiday decorations. And because it's powered by two AA batteries, if you can't be home for the holidays you can pack one along in a suitcase to remind you of your loved ones.

The electronic Christmas tree is really a 6½-inch high tree-shaped printed-circuit board that's outlined by what appears to be randomly-blinking red, green, and yellow LED's. The tree's trimming is the components for the electronic circuit that makes the LED's wink and blink. The Christmas tree's base consists of two AA-size battery holders cemented together with the tree's PC board sandwiched between the two. A little imaginative spray painting before the components are installed puts a realistic finishing touch to the Christmas-tree project.

Because the LED's are continuously cycled *on* and *off*, two alkaline batteries provide more than 300 hours of continuous operation: that's enough to provide almost two full weeks of window display or entertainment before the batteries need to be replaced.

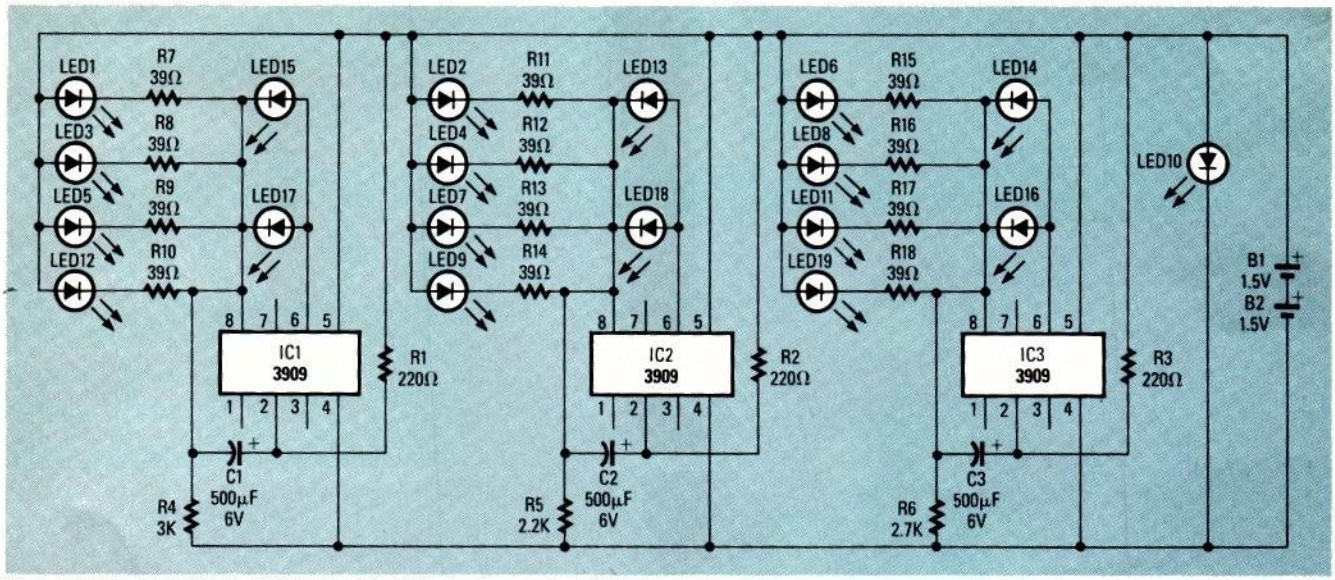


**FIG. 1—THREE INDIVIDUAL FLASHER CIRCUITS having unrelated flash rates create a pseudo-randown blinking of the LED's because the LED's from each individual circuit are intermixed around the edges of the tree.**

### How it works

As shown in Fig. 1, three individual flashing circuits that use an LM3909 LED flasher/oscillator IC create the appearance of a pseudo-random firing order. The combination of C1/R4, C2/R5, and C3/R6 control the blink rate, which is between .3 and .8 second, while the inherent wide tolerance range (−20% to +80%) of standard electrolytic capacitors add to the irregularity of the blink cycles. The continuous current drain is about 10 mA; however, if you decrease the values of R4–6 or C1–3 in order to to increase the blink rate, the current will then increase proportionately.

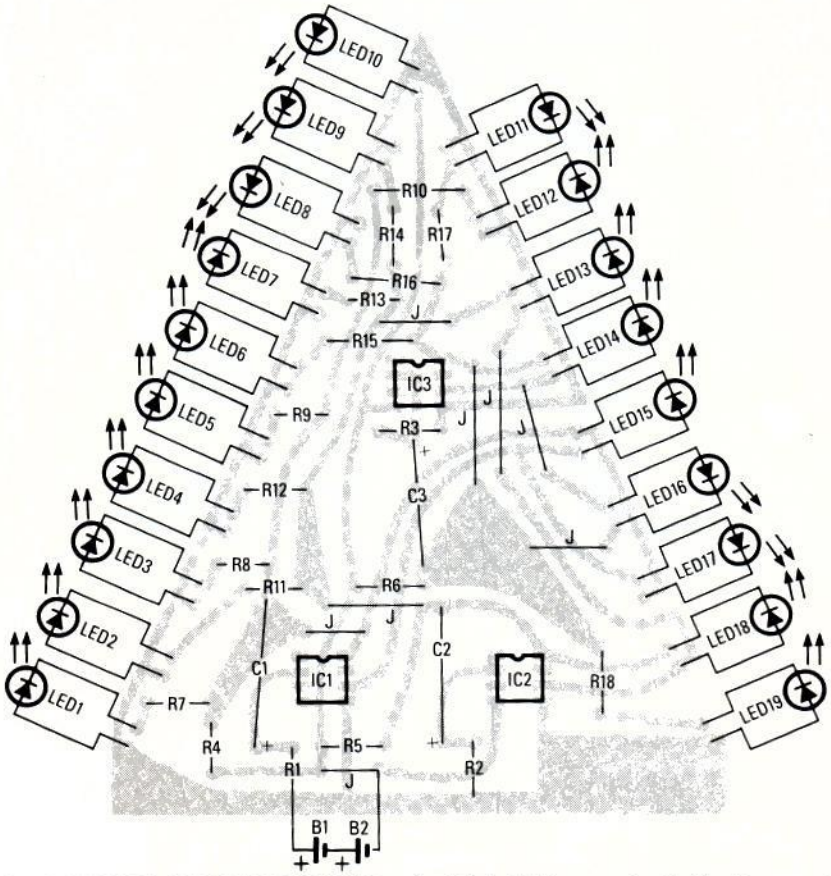


**FIG. 2-TAKE EXTRA CARE THAT THE LED'S are installed with the correct polarities. If you want to decorate the "tree", do it before drilling the mounting holes for the components.**

**PARTS LIST**

**All resistors are ¼-watt, 5%.**
R1–R3—200 ohms
R4—3000 ohms
R5—2200 ohms
R6—2700 ohms
R7–R18—39 ohms
**Capacitors**
1–C3—500 µF, 6 volts, electrolytic
**Semiconductors**
IC1–IC3—LM3909, LED flasher
LED1, LED4, LED7, LED13, LED 16, LED 19—Red, diffused 5-mm LED
LED2, LED5, LED6, LED11, LED14, LED17—Yellow, diffused 5-mm LED
LED3, LED6, LED9, LED12, LED15, LED18—Green, diffused 5-mm LED
LED10—Red flasher LED (Radio Shack 270-401 or equivalent)
**Other Components**
B1, B2—1.5-volt AA alkaline battery
**Miscellaneous:** battery holders, PC board, wire, solder, etc.

**Note: An etched and drilled PC board is available for $10 postpaid from Fen-Tek P.O. Box 5012, Babylon, NY 11707-0012. NY residents must add appropriate sales tax.**

Note in partcular that external current-limiting resistors aren't needed for LED13 through LED18; the resistors are built into the IC's. LED10, which serves as the tree's "star," is a special kind of flashing LED that blinks continuously at a fixed rate.

Power can be turned off by simply removing either battery, or by slipping a small piece of paper between any battery and either of its battery-holder terminals. Of course, a switch can also be added.

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## XMAS TREE

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### Construction

The PC board can be made photographically using the foil pattern shown in PC Service, or the pattern can be used as a guide for applying liquid and tape resist by hand. Although the foil pattern itself is only 5-inches high, the PC board material must be 6¾ inches high because the tree's 1¼-inch trunk is part of the PC board. Since etching large copper areas not only takes excessive time but also shortens the life of the etchant, we suggest you trim away the unwanted PC board material before you etch the board. Or, if you prefer to cut the tree to size after the pattern is etched, protect the foil of the large unused trunk area with resist and simply let the copper remain. As long as the trunk's foil doesn't come in contact with any of the circuit traces it makes no difference whether it's there or not.

If you want to decorate the front of the tree, do it before the holes for the components are drilled. For example, the author sprayed the component side with a bright automotive metallic-green paint. To prevent a defined line, a cardboard mask was held about ½ inch above the board. Then, the edge of the PC board was "dusted" with a fine mist of white paint to simulate snow. After allowing for adequate drying, again using a cardboard mask, the trunk portion of the board was painted with a metallic-brown paint.

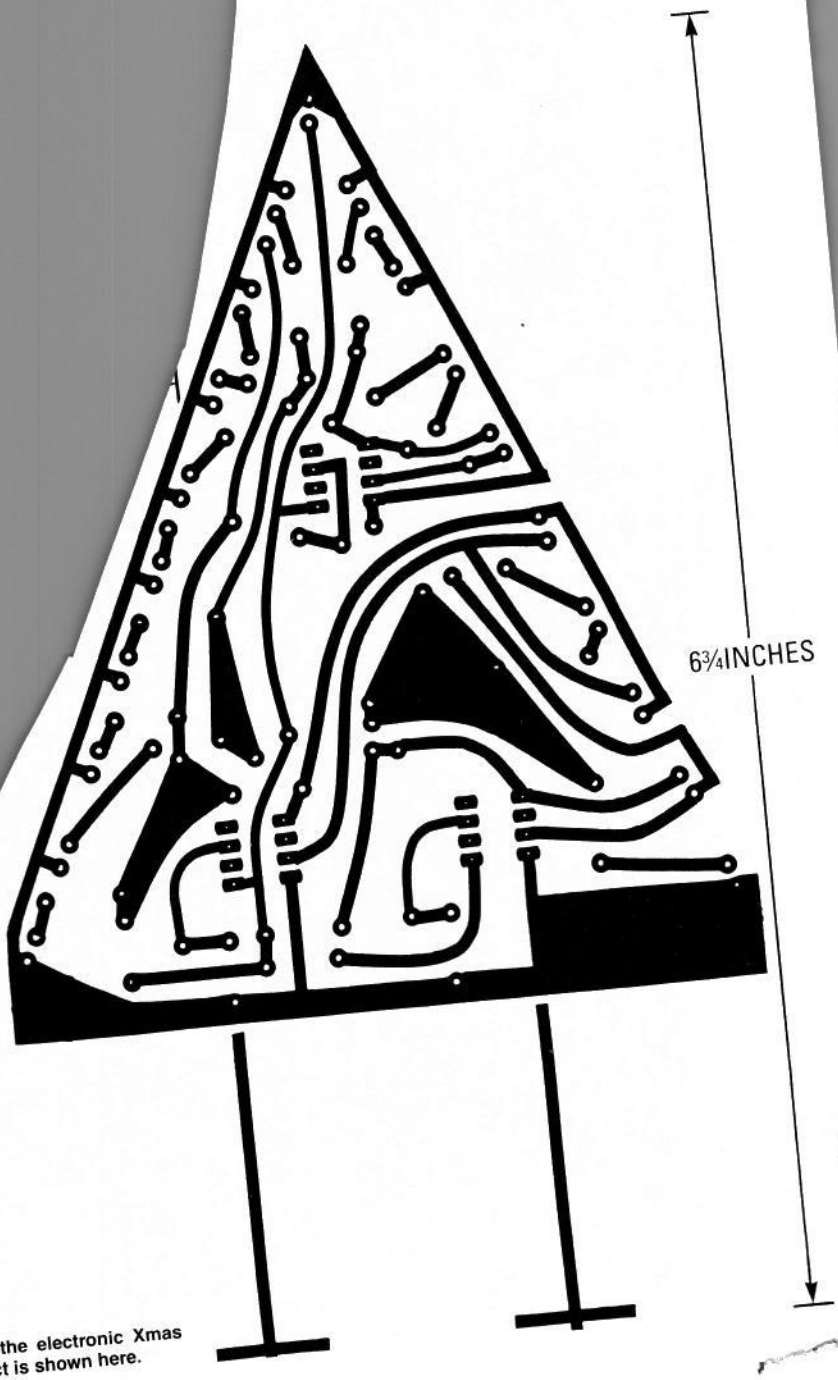
Allow the decorative paint to dry overnight before drilling the component mounting holes. Then install and solder the eight jumpers, the resistors, the IC's, and the capacitors. Then insert all the LED's, observing the polarities shown in Fig. 2. Position the LED's so that they are raised approximately ½ inch off the board. To do that, turn the board over and lay it down on a flat surface, being careful not to allow any LED's to fall out; that can be done easily by holding a piece of stiff cardboard against the LED's while turning the board over. Keeping the board parallel to your work surface, solder one lead of each LED. Turn the board over and carefully look across the surface to see whether the LED's are straight and at the same height. If not, correct as needed. When you're satisfied with their alignment, solder the other lead of each LED.

### Adding the base

Prepare the surfaces of the battery holders and the PC board for gluing by sanding the back of each holder and a ⅜-inch strip on both sides of the circuit board at the bottom of the trunk. Mix a small amount of a 5-minute epoxy and apply some to the ⅜-inch strip on both sides of the circuit board. With the battery polarities opposite each other, sandwich the PC board between the holders. Hold the assembly firmly on a flat surface that's covered with a piece of wax paper. You will have a few minutes working time before the epoxy sets to ensure proper alignment. Make certain that the holders are even and that the circuit board is centered and upright between the holders. In about 5 minutes the glue will have set up sufficiently, and the tree can be lifted from the wax paper. Use acetone or flux remover to clean excess glue from the bottom of the battery holders. As with most other cleaners, be careful not to touch the painted surface.

After allowing at least one hour for the epoxy to cure, solder a jumper wire at one end of the battery holders, across the adjacenet positive and negative terminal lugs. From the battery source ends, solder the positive and negative leads directly to the foil traces—as shown in Fig. 2. The LED's will start to flash as soon as the batteries are installed. Any LED that fails is most likely defective, or installed with reversed polarity.

When you're certain the project is working, you can add a final "dress up" by gluing a colorful felt material over foil traces on the back of the board. **R-E**




LIGHT UP THE HOLIDAYS with the electronic Xmas tree. The PC board for that project is shown here.