

Electronic Christmas Tree Kit

Simple! Easy to Build. A great first kit.
Runs for weeks on a standard 9v battery.



Tools:

Soldering iron, solder, wire cutters, small screwdriver, small pliers.

Parts Supplied:

- 1 - Tree-shaped printed circuit board.
- 4 - Resistors, 5.6 meg (R1, R2, R3, R4). Dogbone-shaped parts with a wire on each end. The colored rings tell you its value. Green-blue-green-gold means "5.6 meg".
- 4 - Ceramic Capacitors, 0.1uF (C1, C3, C5, C7). Tan disks with two wires on one edge. They are marked "104Z" which is 0.1uF.
- 4 - Electrolytic Capacitors, 22uF (C2, C4, C6, C8). Black tubes, marked "22uF". **Polarity sensitive!** The wire with the white stripe and "-" goes in the "-" hole on the board.
- 9 - LEDs (D1-D9). Red, green, and yellow tubes with two wires and a rounded top. **Polarity sensitive!** The flat side and short wire goes in the holes toward the top of the board.
- 1 - 4093 quad NAND gate integrated circuit, marked "CD4093BE". **Polarity sensitive and Static-sensitive!** The end with the notch goes toward the top of the board.
- 2 - Battery snaps with screws and nuts (one positive, one negative).

Safety:

- Soldering irons are hot! Do not touch the tip, or a connection you just soldered.
- When you cut a wire, the cut piece can shoot off and hit you in the eye!
Cut it over a wastebasket to catch the flying piece.

Assembly:

Do you have everything? Then let's begin! Follow these step-by-step instructions. Install each part as shown. All parts (except the battery) go on the **top** side (with the lettering). Solder each part on the **bottom** side (with the wiring). Place a mark in the box (X) as you finish each step. Leave the parts in the bag until you actually need them (they are small, and easy to lose). Take your time and check your work -- it is hard to remove a part if you put it in wrong!

Resistors:

- Bend the wires at each end.
- Put a wire in each hole.
- Push it against the board.
- On the wiring side, bend the wires so they won't fall off.
- Solder each wire, and cut off the extra length.

- R4 5.6 meg
- R3 5.6 meg
- R1 5.6 meg
- R2 5.6 meg

Ceramic Capacitors:

- Put a wire in each hole.
- Position the body close to the board.
- Solder each wire, and cut off extra.

- C7 0.1uF
- C5 0.1uF
- C1 0.1uF
- C3 0.1uF

Integrated Circuit:

- Static sensitive! Keep it in its packaging until ready to use.
- Polarity sensitive! Put it on the board with the notch and "CD..." end of the part number on top.
- Bend the pins inward a little to fit into the holes.
- Solder all 14 pins, and cut off the extra length.

- U1 CD4093BE

Electrolytic capacitors:

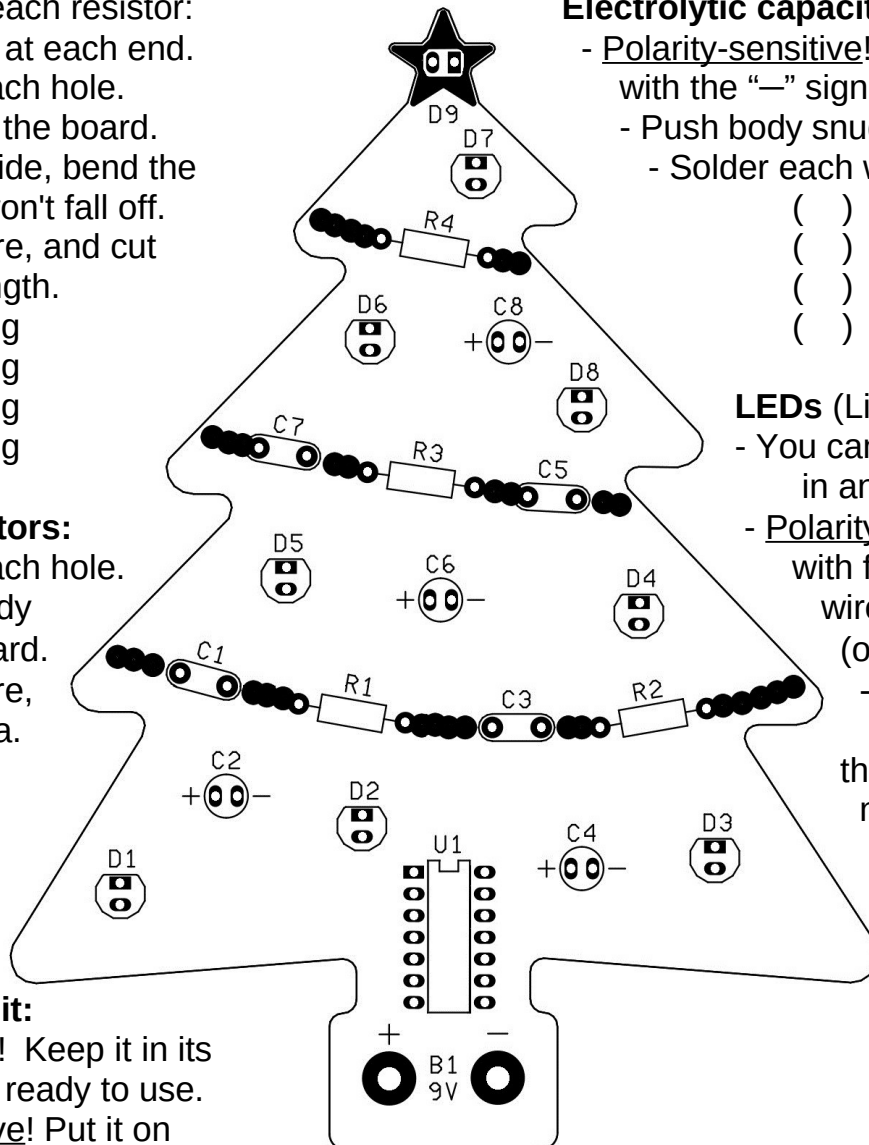
- Polarity-sensitive! The wire on the side with the "-" sign goes in the - hole.
- Push body snug against the board.
- Solder each wire, cut off extra.

- C8 22uF
- C6 22uF
- C2 22uF
- C4 22uF

LEDs (Light-Emitting-Diode)

- You can put any color LED in any location D1-D9.
- Polarity-sensitive! Put side with flat spot and shorter wire in the **top** hole (or **right** hole for D9).
- Solder **one** wire of each LED. Be sure they are straight, and not in backwards.
- Then solder the other wire.

- D9
- D7
- D6
- D8
- D5
- D4
- D1
- D2
- D3

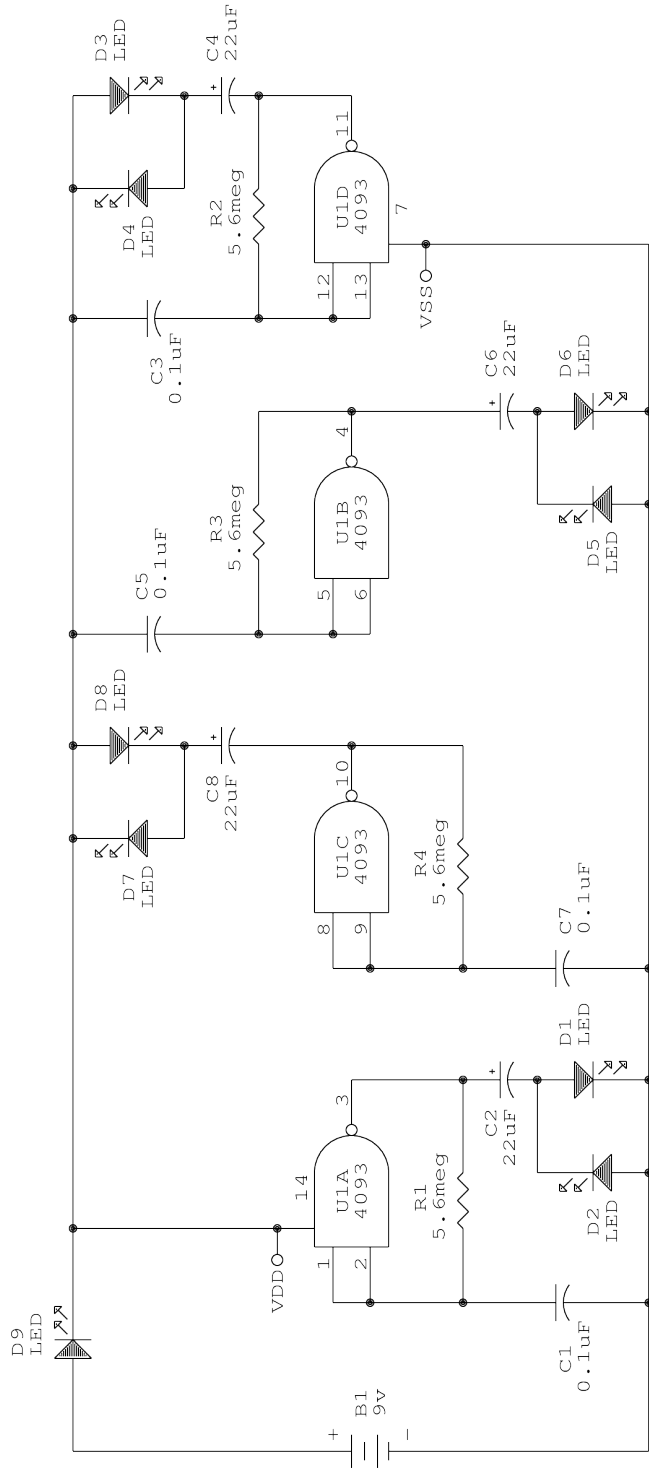


Battery Snaps:

- Find the **big** snap with the screw and nut.
 - Put your finger on top, and unscrew the nut.
 - Put the screw and snap in the "+" hole from the **solder** side.
 - Put the nut on the printed side. Only get it finger-tight for now.
- + battery snap
 - battery snap (Mount it the same way as the + snap).

Plug a standard 9v battery onto the battery snaps. The + side of the battery should match the + on the board. **The LEDs should all start blinking!** Now tighten the two nuts. The battery will hold them in exactly the right place so it snaps on and off easily.

Doesn't work? See if the battery is dead, or the snaps are on backwards. Look for parts in the wrong place or backwards, or bad solder joints. If two LEDs don't work, see if one of them is backwards. For help, contact Lee A. Hart, 814 8th Ave N, Sartell MN 56377, 320-656-9574, leeahart@earthlink.net.



Theory of Operation

U1 is a quad Schmitt-trigger gate. Each section is wired as a ~2 Hz RC oscillator (R=5.6meg, C=0.1uF). Each output has a series 22uF capacitor, powering two back-to-back LEDs. One LED lights on the rising edge, and the other on the falling edge. LED current is only limited by the gate's output impedance, so each flash is short but bright to minimize power consumption. Each oscillator is wired slightly differently, so discourage them from synchronizing. D9 is wired in series with the battery to also act as a blocking diode in case the battery is connected backwards.

Parts List:

- U1 - CD4093 quad 2-input Schmitt trigger NAND gate
 - D1-D9 - LEDs, any color or type
 - C1,3,5,7 - Capacitor, 0.1uF ceramic
 - C2,4,6,8 - Capacitor, 22uF electrolytic
 - R1-R4 - Resistor, 5.6 megohms 5% (green-blue-green-gold)
 - B1 - 9v battery snaps (can be salvaged from a dead 9v battery)
- two #2-56 machine screws and nuts to mount battery snaps

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