

What's Inside



Not included: Soldering iron, solder wire, flush cutters, phillips screwdriver.

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Designed in California, Made in USA



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NITELIGHT LANTERN

Build a lantern that turns on when it gets dark... and learn how transistors work in the process.



Electronics, engineering and coding solutions designed by educators for hands-on learning.

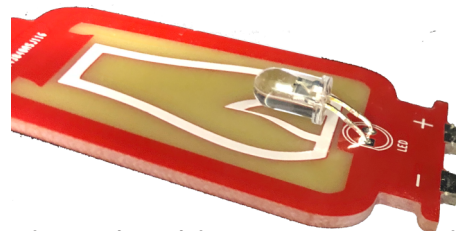
Instructions

1. Prepare workspace: Find a clear, well ventilated (ideally with a fume extractor) space and wear goggles.



2. Insert Components: Bend resistor leads and insert. Insert transistor with flat side aligned with image on board. Insert photo-transistor with long lead in hole with round pad. Bend leads on back of board so components don't fall out.

Put LED into lantern with long lead in hole with round pad but don't push flat, bend LED with approximately 5mm (1/4") of the leads above the hole.

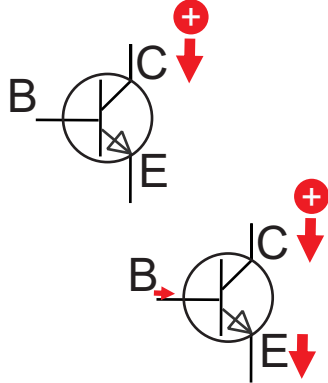


3. Solder Components: Turn board over and touch soldering iron to pad and component wire at the same time. Wait a few seconds then touch with solder wire. Make sure solder wire melts into hole and doesn't ball above the pad.

4. Assemble: Screw nightlight coin to battery PCB and gently push Lantern into base. Make sure + and - are aligned in both steps when assembling.

This circuit uses two transistors and two resistors to create a logic circuit to turn on an LED when the light gets darker than the ambient light.

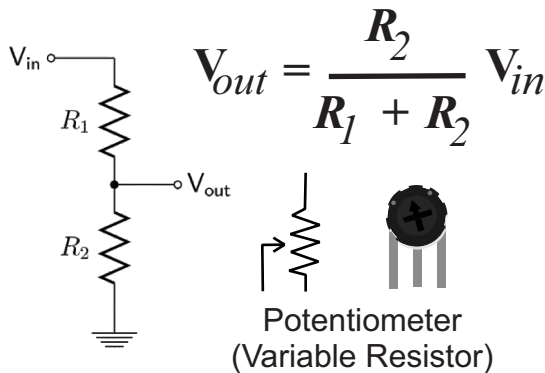
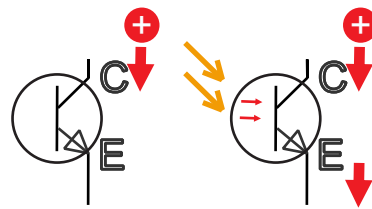
How does it work?



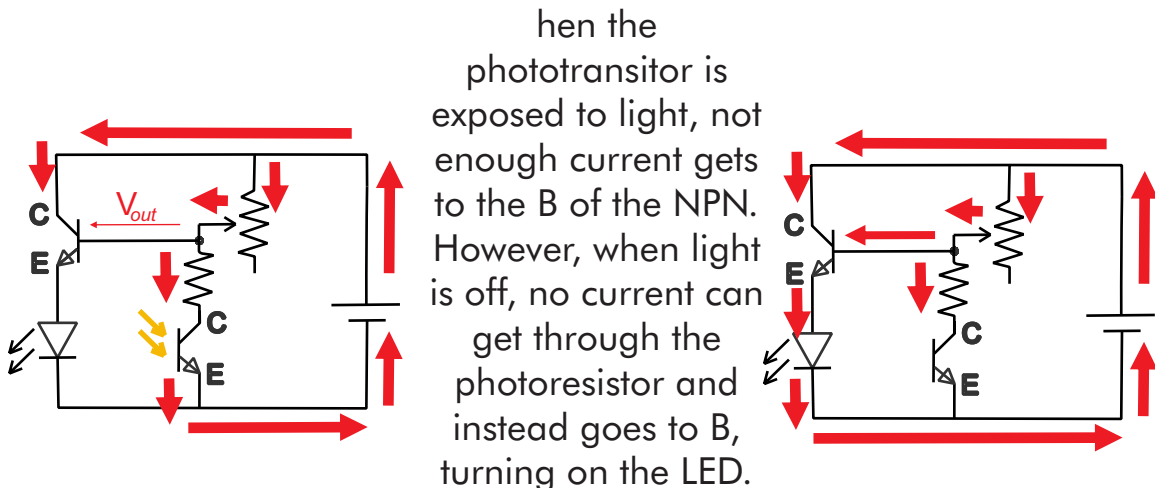
The NPN transistor functions as a switch. It has three wires: Collector (C), Base (B), Emitter (E).

When there is no current going to B, no current can get past the C. However, if enough current gets to B, then the transistor "opens" like a switch letting current through C to E.

The phototransistor also functions as a switch. It is similar to the NPN with only two wires: Collector (C), Emitter (E). It converts light energy as the Base (B). If there is no light, no current can get past C. The stronger the light, the more current can get past the C to the E.



The last piece of the puzzle is the two resistors which function as a **Voltage Divider**. The voltage going to the B (V_{out}) of the NPN transistor is calculated based on the relationship between the two resistors. We turn the potentiometer so that at ambient light, V_{out} is too low to B to let current through.



When the phototransistor is exposed to light, not enough current gets to the B of the NPN. However, when light is off, no current can get through the photoresistor and instead goes to B, turning on the LED.