Understanding Schematics

Learn how to read and interpret schematic diagrams.

Site: iCODE
Course: Machine Science Guides (Arduino Version)
Book: Understanding Schematics
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Schematic Diagrams

A *schematic diagram* is a "blueprint" for an electronic circuit. It shows which components a circuit contains, and how they are connected. Figure 1 shows a schematic for an LED clock. While the diagram may look complex, it includes only a few different types of electronic components. Click to enlarge the schematic, and see if you can identify any of the components.

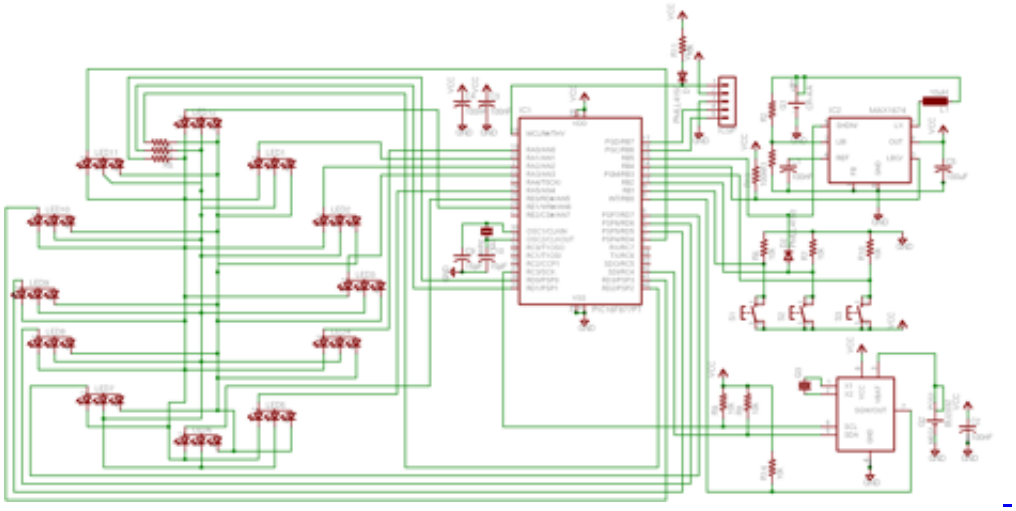

Figure 1. LED clock schematic (click to enlarge).

In a schematic diagram, electrical connections between components are represented by horizontal and vertical lines (often these lines are green). Importantly, the intersection of a horizontal and a vertical line *does not represent* an electrical connection. A connection is symbolized only if the intersection is marked with a dot, as shown in Figure 2.

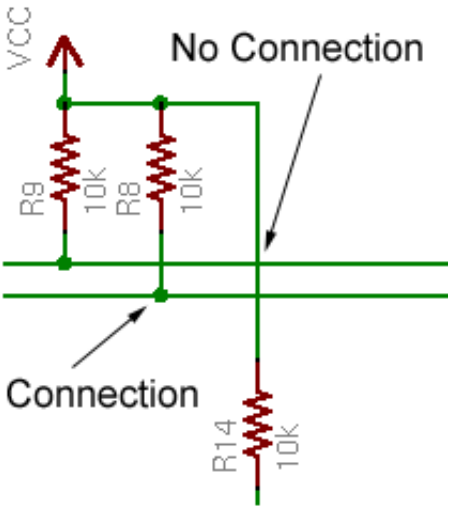

Figure 2. Intersecting lines.

Schematic Search

Using the component symbols shown in Figure 3, count the number of power and ground connections, LEDs, resistors, capacitors, and switches shown in the segment of the LED clock schematic shown in Figure 4.

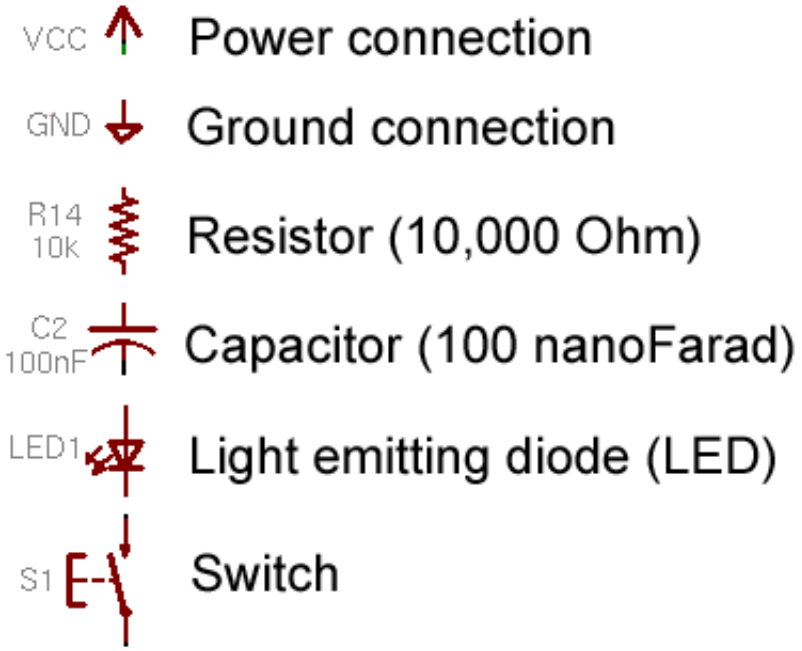

Figure 3. Component symbols.

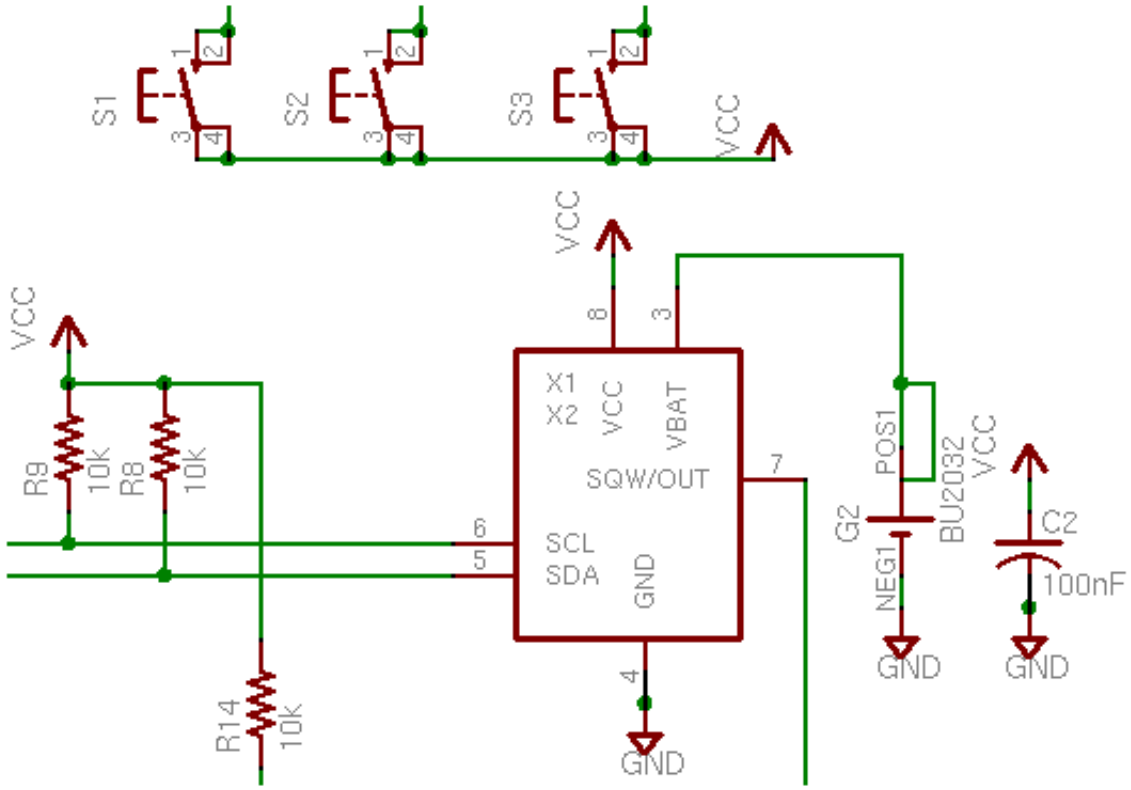

Figure 4. Portion of LED clock schematic.

About the Seven-Segment Display

In the next step, you will add a component to the breadboard called a *seven-segment display*. These components are widely used in the numerical displays on digital clocks, digital thermometers, and other home appliances, such as DVD players and microwave ovens. Their name derives from the number of individual light segments required to produce every digit from 0 to 9 on the display. If you look closely at the devices shown in Figure 5, you can count the individual segments.

Figure 5. Devices that have seven-segment displays.

Figure 6 shows the seven-segment display included in your kit. Note that the component has seven different segments and a decimal point on its top face. Each segment and the decimal point can be lit individually to produce different numbers on the display.

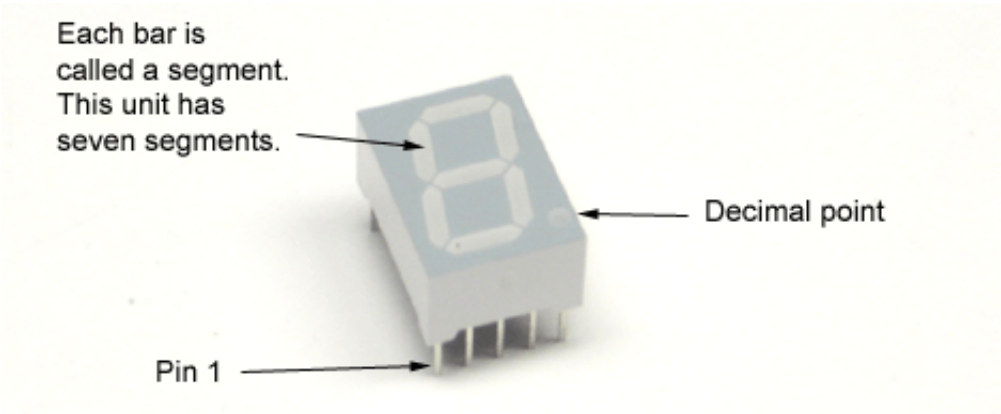

Figure 6. Seven-segment display.

Like many electronic components, the seven-segment display has pins on its underside that connect it with power, ground, or other components. On the seven-segment display, the pins are numbered from 1 to 10. With the display oriented so the decimal point is in the lower-right corner of the top face, pin 1 is under the lower-left corner. The remaining pins are numbered counterclockwise starting from pin 1, as shown in Figure 7. Note that, in schematic diagrams, a pin's orientation *does not reflect* its physical position on the component. In fact, pins *usually* appear out of place and out of numerical order.

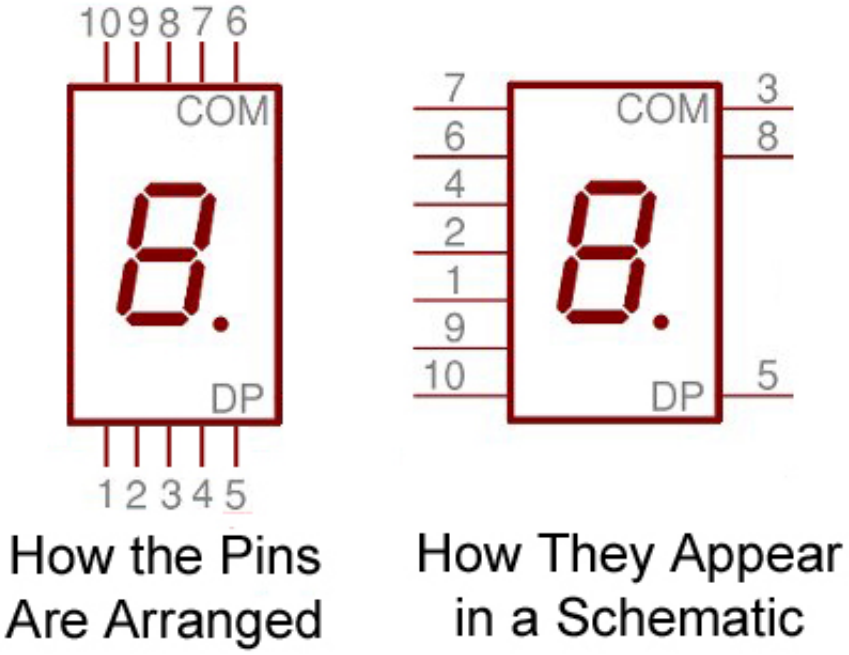

Figure 7. Pin numbering on the seven-segment display.

Build the Seven-Segment Display Circuit

Following the schematic shown in Figure 8, construct a circuit on the breadboard with the seven-segment display. You can position the seven-segment display on the board wherever you like, provided pins 1 to 5 are on one side of the breadboard's center groove, and pins 6 to 10 are on the other side of the groove. Note that two 390 Ohm resistors are required to build this circuit.

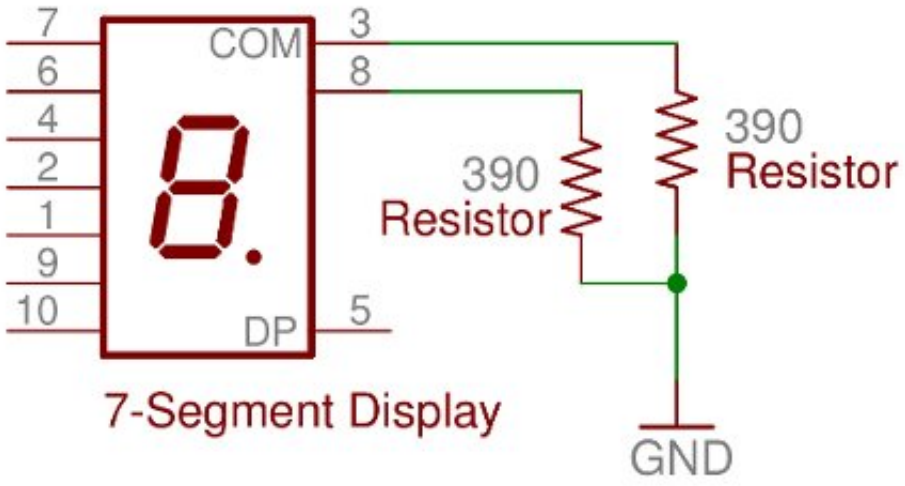

Figure 8. Seven-segment display circuit.

Lighting the Segments

Lighting the segments of the seven-segment display is a good application for a flexible jump wire. One end of the jump wire should be inserted into a power hole, and the other can be easily moved about among pins 1, 2, 4, 5, 6, 7, 9, and 10 on the seven-segment display.

1. Move the battery pack's power switch to the ON position.

2. Insert one end of a flexible jump wire into any open power hole (any hole marked with a red line).

3. Insert the other end into any open hole aligned directly above or directly below a pin on the seven-segment display, as shown in the video and in Figure 9. ***NOTE: Do not let the tip of the jump wire touch either resistor!***

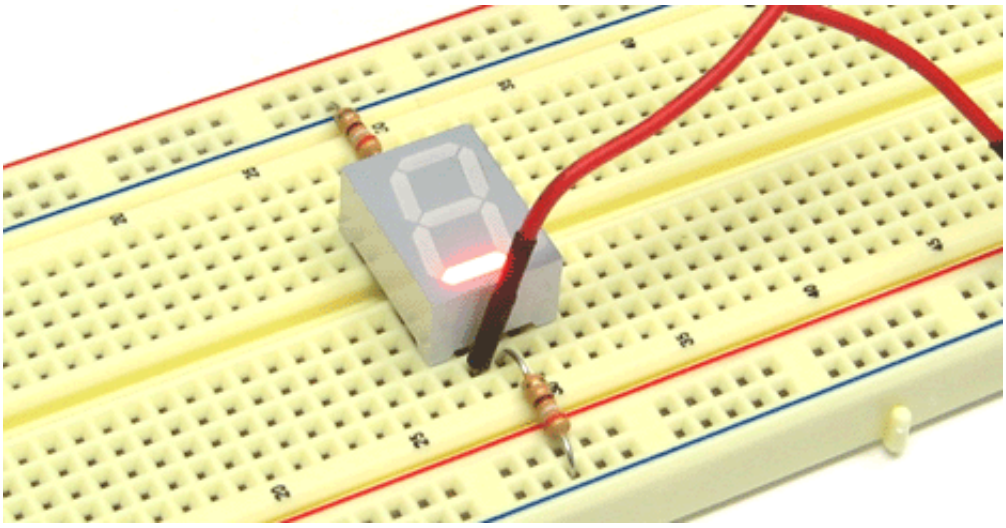

Figure 9. Flexible jump wire connecting power to pin 2, causing one segment to light.

Making Numbers and Letters

With multiple jump wires in place, you can create numbers and letters on the seven-segment display.

1. Using additional jump wires, light combinations of segments to produce an number from 0 to 9 on the seven-segment display.

2. Arrange the jump wires to display one of your initials. ***NOTE: Some letters cannot be made, and some can be produced only in their lowercase form.***