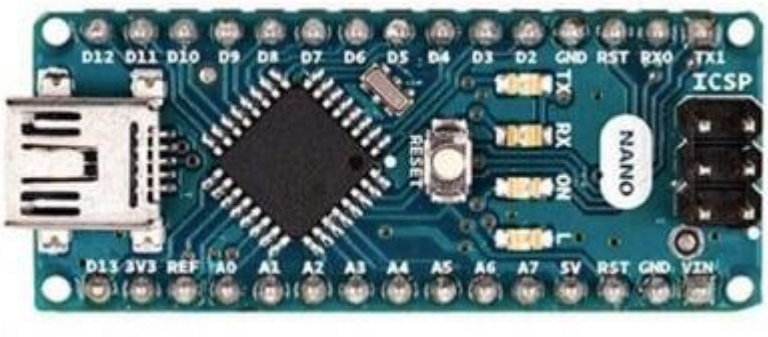
Lab 5-Soldering a PCB

Learning Outcomes:

- Learn about PCBs
- Learn to solder a PCB

Background:

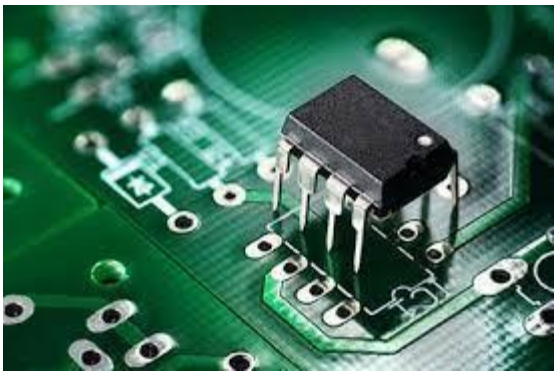
Printed circuit boards (PCBs) are an important part of most modern electronics. Electronic circuits use many different components, and these components communicate through the PCB. A PCB consists of a flat sheet of insulating material and a layer of copper. The copper layer is then mechanically or chemically etched into separate tracks called traces. These traces are the ‘wires’ of the PCB connecting each individual component in the proper manner.



Arduino Nano. Image courtesy of [Arduino]

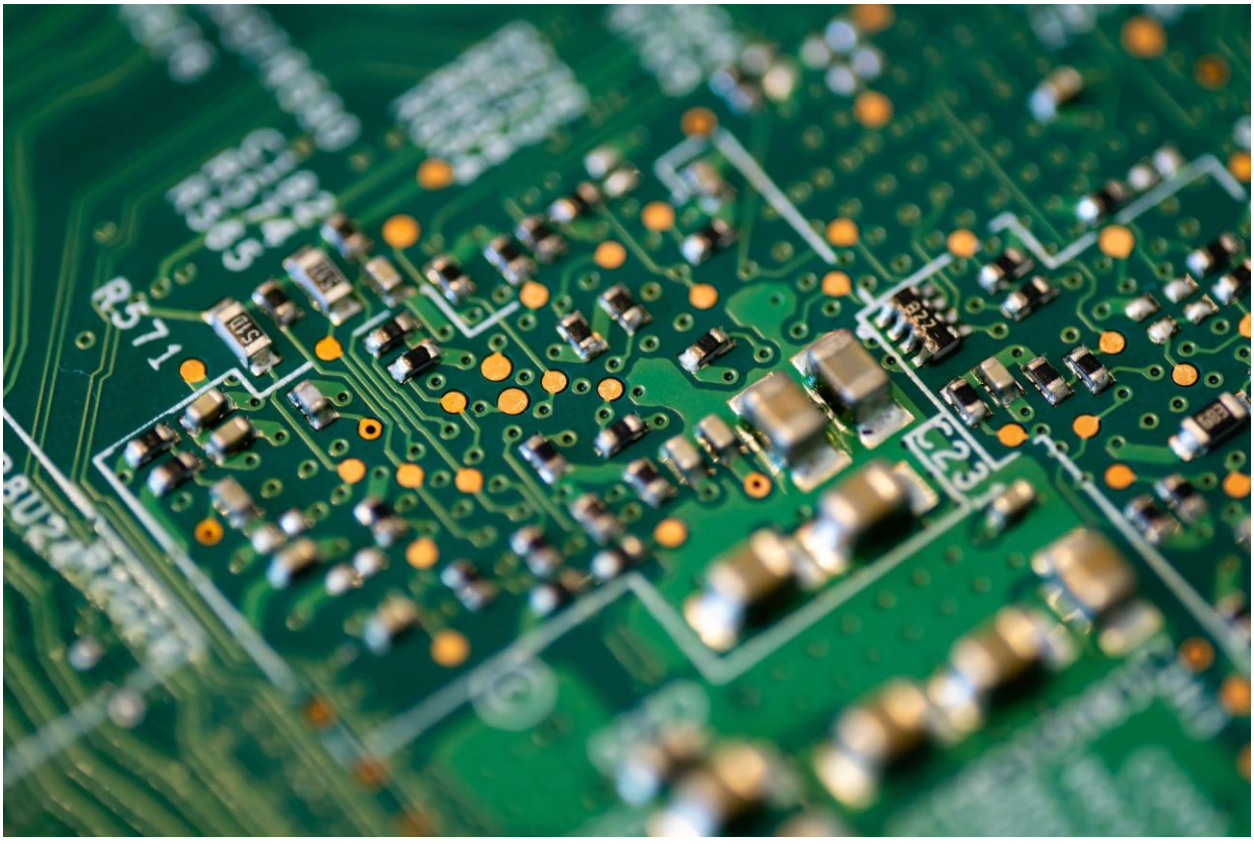
The Arduino Nano above includes a PCB. The Arduino Nano’s components are all mounted onto the PCB (blue wafer) and you can see it’s traces between the components on the front and back.

There are two different types of PCB components. One called through-hole and the other called surface mount. Each offers its own pros and cons. Through-hole components have leads that are inserted through holes on the board, thus the name, and soldered into copper traces on the other side. Through-hole manufactured boards are easier for humans to make because they are bigger than surface mounted components; however, they also take up more space.



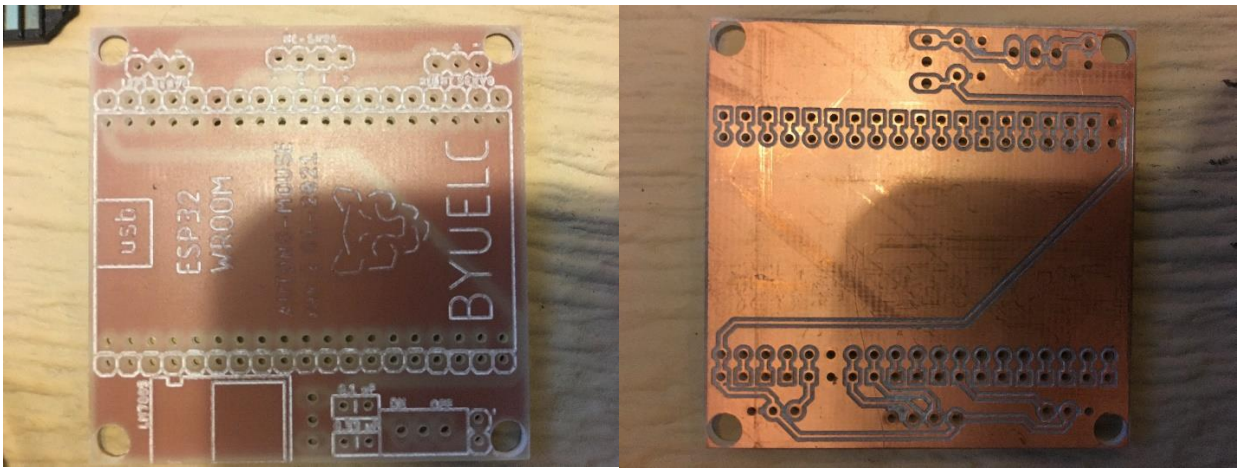
Through-hole pcb. Image courtesy of wellpcb.com.

Surface mounted PCB technology came about in the 1960s and gained widespread popularity by the mid-1990s. Components were designed to mount directly to the surface of the PCB. This cuts down on their size allowing more compact design. However, it makes manual soldering a pain. Robots are typically used to place and solder these components.



Surface Mounted PCB. Image courtesy of neodenusa

The ELC has a PCB mill. The mill is a mechanical through-hole mill. Because it's mechanical, the boards are cheap but they not as high quality as a chemical commercial PCB manufacturer. The copper PCBs in your kit are from the ELC PCB mill.



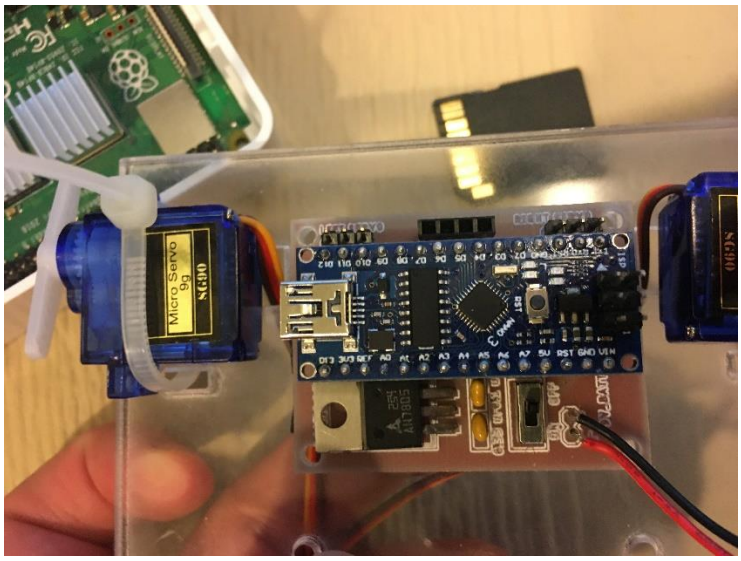
ELC Copper PCBs

For the next part of this lab, you will solder on components to your PCB and learn how to test for connectivity between each of them.

Part 1 Solder a PCB:

1. Gather your components (PCB, voltage regulator, switch, 0.1uF capacitor, 0.33uF capacitor, battery cap, 2 3-pin male headers, 1 4-pin female header, 2 15-pin female headers)
2. Find a solder station
3. Follow the board layout and solder each of your components to the top of the PCB.
4. As you're going along use a multimeter set to connectivity setting to check each connection on your PCB. For example, each trace should connect each of the pin's part of its circuit but should not connect other traces. If you by chance have solder connecting two different traces then you have a shorted circuit. That will make your car fail. (Look at lab 1 for extra material on testing connectivity)

Once you've finished your PCB should look something like this:



If you've checked to make sure you didn't short anything, place your Arduino Nano into the header pins. Make sure to check the orientation.

Part 2 Test the PCB:

WARNING: Because of the Arduino Nano receives power from the USB make sure that the Arduino is never plugged into the computer while it is inserted in the PCB. If you want to reprogram your Arduino, take it out of the PCB, program it, reinsert it, and power with your battery.

Try inserting and testing a servo using the code provided from lab 3 or inserting and testing the HC-SR04 ultrasonic sensor from lab4. If you soldered your PCB correctly you should get the same results as before. Make sure it works or your car will not work for the final lab.