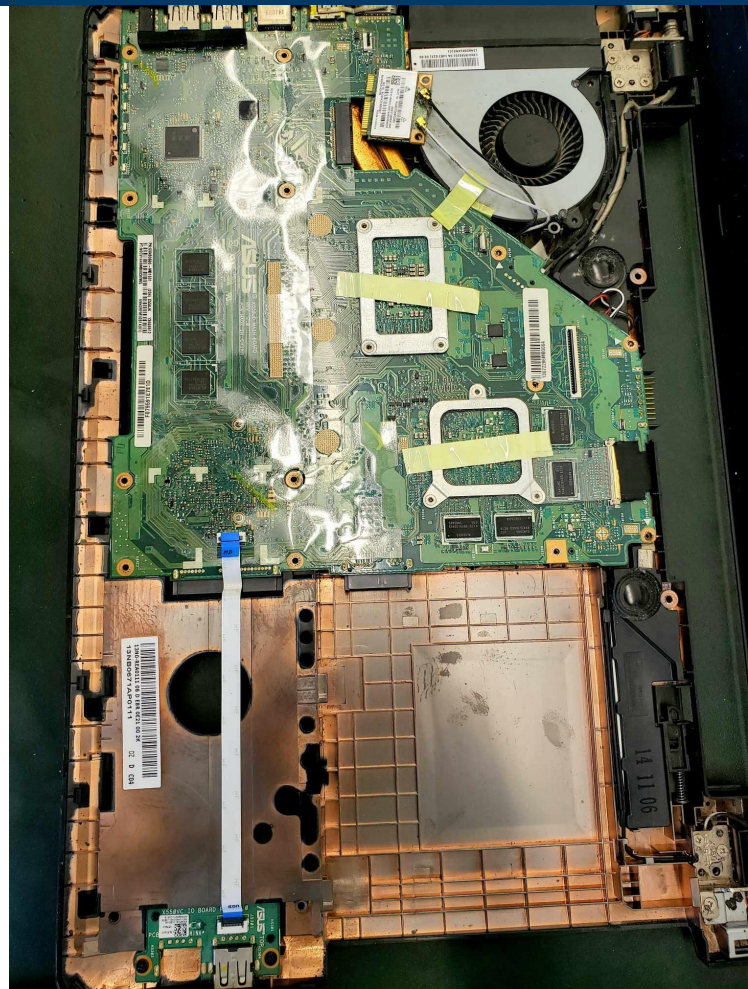


Electronic Repair

Circuits and the Circular Economy!
Week 2

October 5 2024



Land Acknowledgement

<Add land acknowledgement>



Table of Contents

01

Staying Safe

03

Disassembly

05

Finding the Problem

02

Approaching a Repair

04

Understanding a Circuit

06

Fixing the Problem

07

Repair and Repairability



Safety first!

Staying safe working with electronics

Lets review the safety tips from last session.

Preparing your workstation

Self

- Tie back **long hair**
- Take off dangling **jewelry** and rings
- Remove **loose clothing** (eg. scarves, or baggy sleeves)

Space

- Check for **tripping hazards**
- Work on a **stable, dry surface**
- **No food & drink**

Device

- Look for **warning stickers**
- Inspect the device for **sharp edges.**

Staying Safe working with Electronics

How to not get shocked!

1. Unplug the device

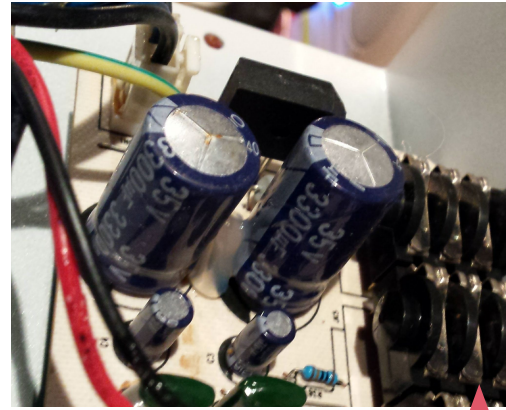
The AC power coming from wall sockets is especially high power!

2. Remove batteries

Most batteries are lower power, but we still need to remove them before starting our work.

3. Watch out for large capacitors

Big capacitors can store charge for a long time. Watch out for these, and ask for help if you notice one.



More safety hazards

1. Batteries

Battery chemicals can be dangerous if they are broken or punctured. Keep an eye out for this, and don't touch damaged batteries.

2. Chemicals

Circuits, especially older ones might contain chemicals like mercury or lead. **Wash your hands** after touching a circuit.

3. Dangerous devices

Some devices are especially dangerous. Avoid high power appliances (like washing machines), microwaves, old fashioned cathode tube TVs, PC power supplies

Activity: Spot the Safety Hazard.

There are some serious safety problems in the picture below? Who can find all 12?

Todo: Make new Graphic



Approaching a Repair

Before we jump into taking things apart, let's ask ourselves a few questions.

Approaching a Repair

To fix a broken device, we first need to understand why its not working.

How is it working now?

If some features work and others don't, that is a useful clue.

What could have happened to it?

Did you drop it? Did it get wet? Is it very old?



Activity: Choose one device

Hopefully you have some broken electronics in front of you.
Choose one that seems like an interesting problem to work on!

Activity: How is it working now?

First of all, figure out how the device is broken.

Ask yourselves some questions:

- 1) What happens when you turn it on?
- 2) In what way is it working? In what ways is it not working?
- 3) What is the history of the device and of the problem? (eg. did you drop it?)
- 4) Do you have any ideas about what part of the device might have broken?



Disassembling a Device

You should have a real device ready at your station, and a set of screwdrivers. Like last session, we'll start by taking off the cover so we can see the circuitry.

Activity: Disassemble your device!

1. Start by finding all the screws - check all sides
2. Unscrew them one by one - but take note of where you put them so that you can put things back together!
3. Careful with prying things apart - ask for help if in doubt.

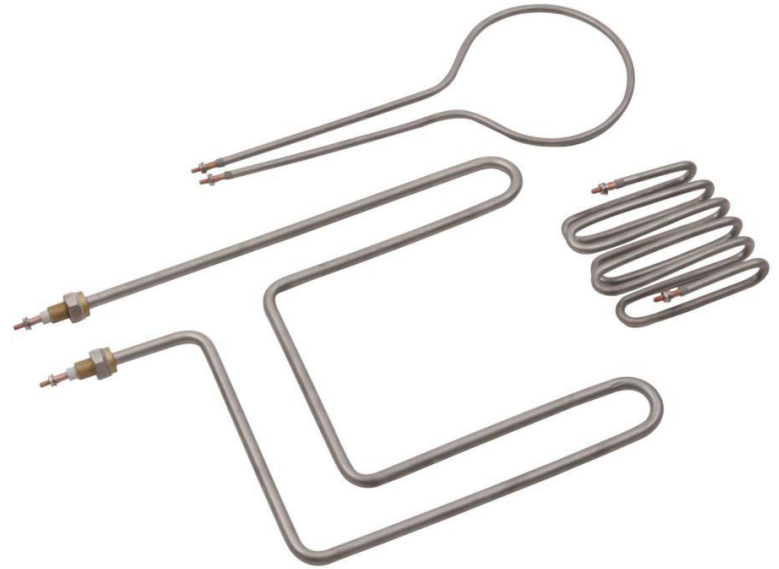
How did the disassembly go?

Could the product be designed in a way that makes this easier?

If we have time...

Heating Elements

A heating coil works essentially as a big chunky resistor with a non-conductive coating. When a lot of electricity passes through it it heats up.



Is there a heating element in your circuit?

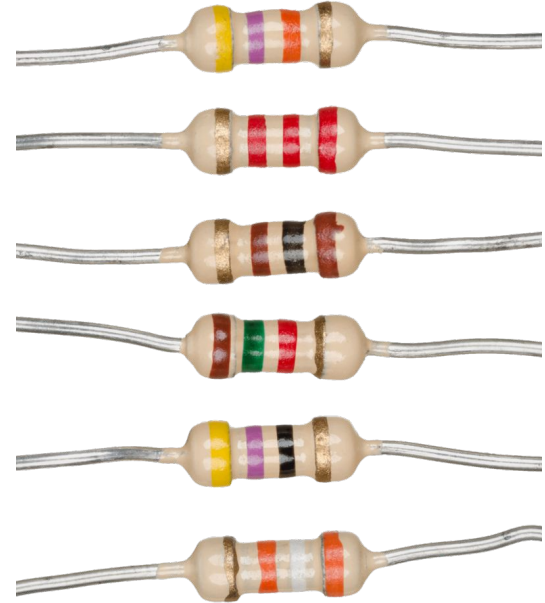


Understanding a Circuit

Like last week, let's try and understand the circuit in front of us. We'll re

Resistors

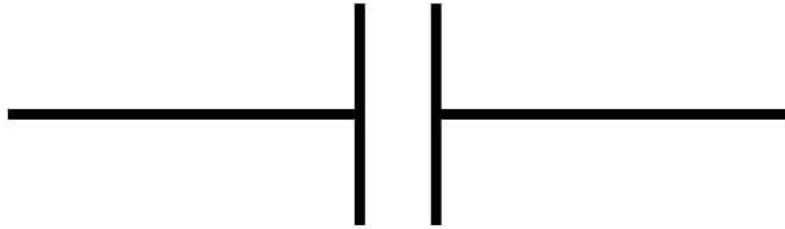
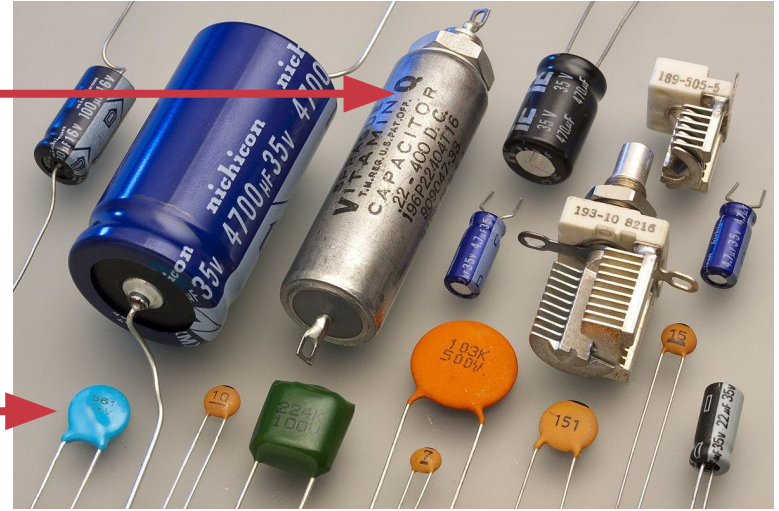
Resistors are usually small components (about the size of a big ant), with colorful stripes. These stripes indicate their resistance (more on that later)



How many resistors are in your circuit?

Capacitors

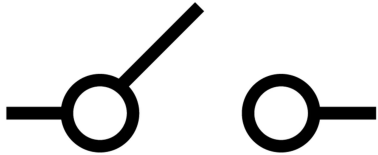
Capacitors often look either like tiny tin cans, or little (often orange) skittles.



How many capacitors are in your circuit?

Switches

Switches are another important part of a circuit that lets the user interact with it - changing settings or turning it on and off.

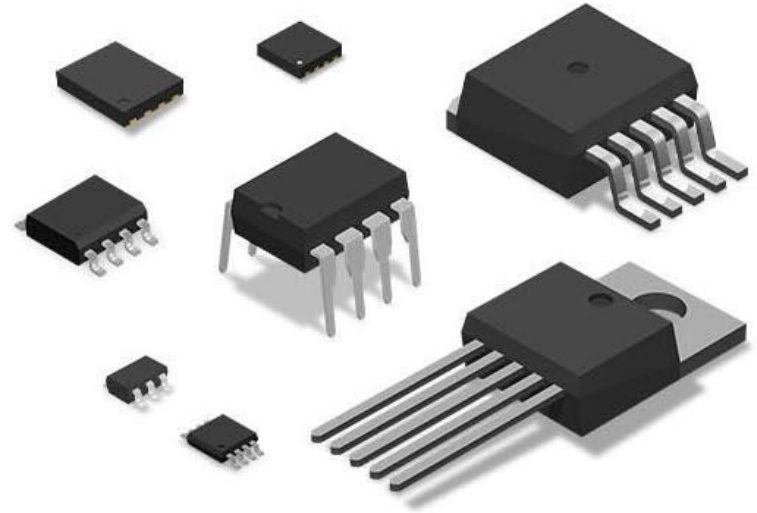


How many switches are in your circuit?

Integrated Circuits

More complicated circuitry might be stored in compact integrated circuits.

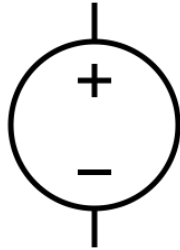
Often these have a part number on them that you can google to find out what it does!



How many resistors are in your circuit?

Power Sources

A circuit needs a power source! The power source could be a battery, or the power might come from a wall outlet.



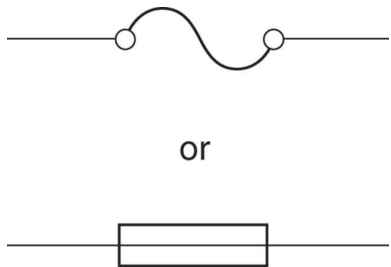
Where is the power source in your circuit?

If we have time...

Fuses

Fuses are important for safety. They stop electricity passing through the circuit if the circuit overheats, or if there is too much electricity passing through it.

Fuses come in many shapes and sizes.



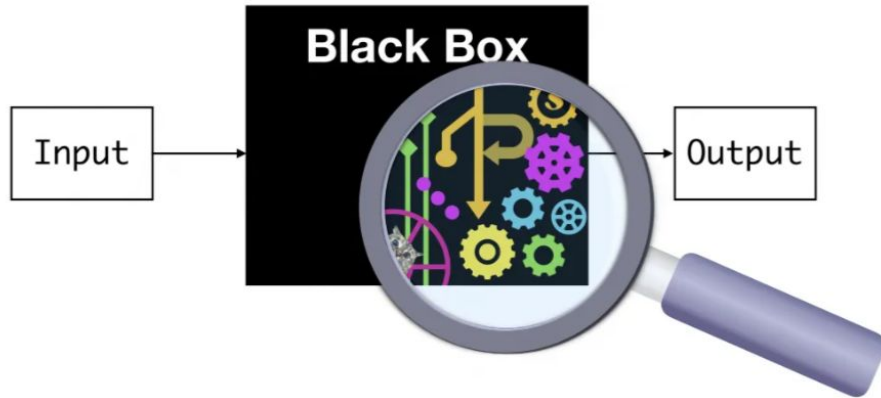
Is there a fuse in your circuit?

If we have time...

Activity: Putting it all together

Draw a diagram of your circuit, including all the resistors, capacitors, switches, power sources and heating elements that you've found, and how they're connected.

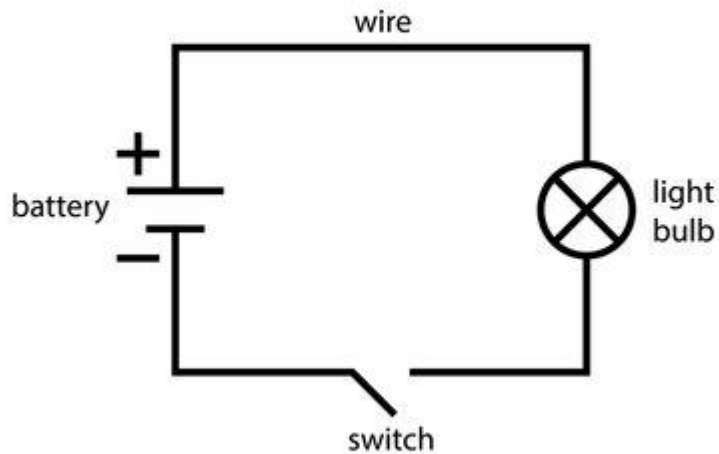
If you aren't sure about something that's ok for now! Put it into the diagram as a 'black box' of unknowns.

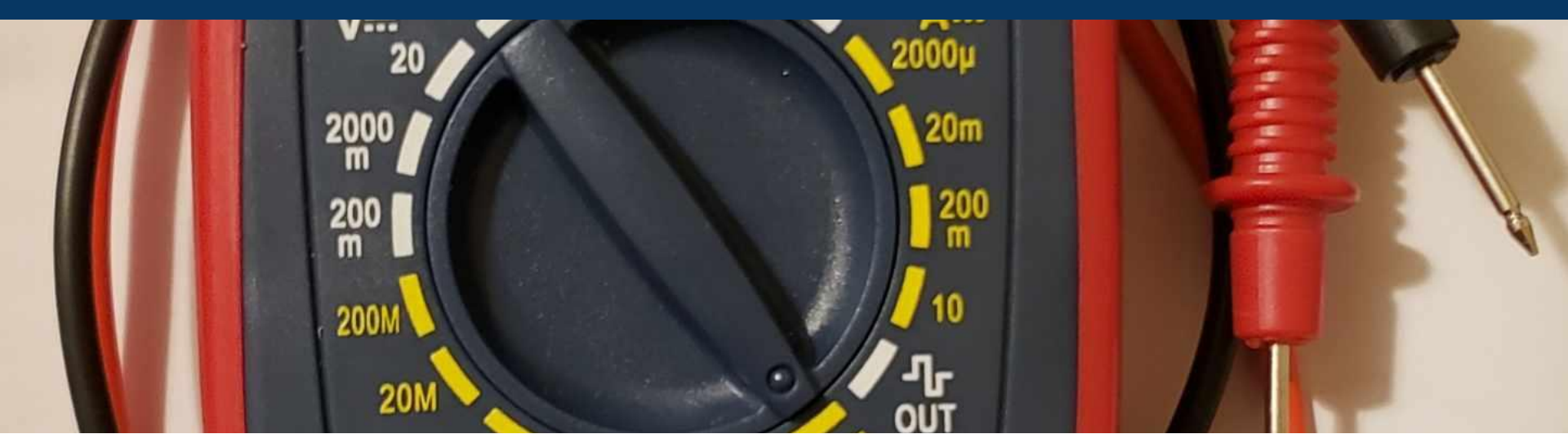


If we have time...

Activity: Putting it all together

For example, in this circuit a battery, switch and light bulb are all connected.





Finding the Problem

If it isn't already clear, the next step is to start searching for the problem. Why isn't the circuit working the way it should?

Disconnected Wires or Loose Connections?

Sometimes when something is dropped, or not connected very well to begin with, wires can become loose. Even loose connections can cause problems. You can check that the wires are connected the way you expect with a multimeter.

Do you see any wires or components that look loose or disconnected?

Review: Testing continuity

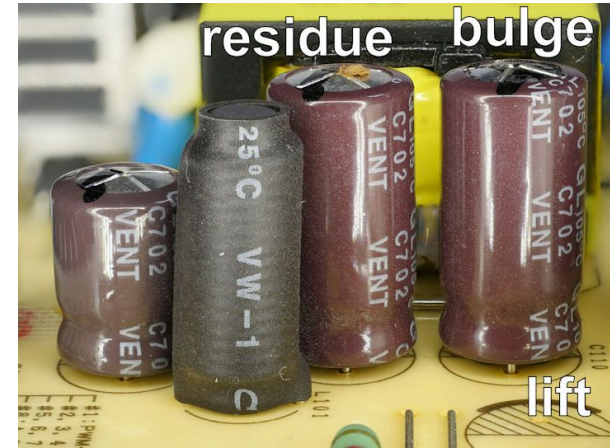
1. Switch the multimeter dial to continuity mode.
2. Touch the multimeter dials to two points of the circuit that you think should be connected (Like two ends of the same wire)
1. Connected? The multimeter should display '0' and beep



Burnt out capacitors?

Sometimes it is possible to spot when a capacitor is broken. You can also check capacitance with a multimeter.

On the capacitors, or other components, do you see any marks or residues, or things that look burnt?



Blown fuses

Thermal fuses might blow if the device overheats, and might need to be replaced. You can use a multimeter to check continuity across a fuse: a good fuse will be like a wire and the multimeter will beep. For a blown fuse, it will be an 'open circuit' and the multimeter won't beep.

Do you see any thermal or electrical fuses in your circuit?

Activity

Take a closer look at the circuit to try to find the problem, checking for

- **Loose connections**
- **Broken capacitors**
- **Blown fuses**

And anything else that looks suspicious.

Use your multimeter to investigate more closely.

Activity

Has anyone identified the problem with their circuit?



Fixing the Problem

Maybe we found the problem, maybe we need more time. If we found the issue, what steps can we take to fix it?

Fixing loose connections

Loose connections can be fixed using a soldering iron. Using a soldering iron, you can melt liquid *solder* to connect two wires or components together.

This can take some practice!



Replacing broken parts

If you found a blown fuse or broken capacitor, you may be able to replace it to fix the device. You'll need a replacement part with the **same specifications**.

Activity: Lets fix something!

Lets watch an example of fixing a loose connection using a soldering iron. Gather around the soldering iron stations to watch a demonstration.



Repairability

Was this repair easy? If not what can be done to make it easier.

Right to Repair

Last week we talked about Right to Repair legislation, and how it can make manufacturers...

- Provide repair manuals
- Offer parts for sale
- Share diagnostic tools
- Adjust warranty policies

Would these things have helped you with your repair?

Design for Repairability

When designing a new product, engineers make important decisions that can impact repairability of a product.

What aspects of the current design of your device made repair difficult? easy?

Activity: Design for Repairability

In groups, talk about what could be changed about your device to make it more repairable.

Can you propose a new and improved, more repairable device?

What have we learned?



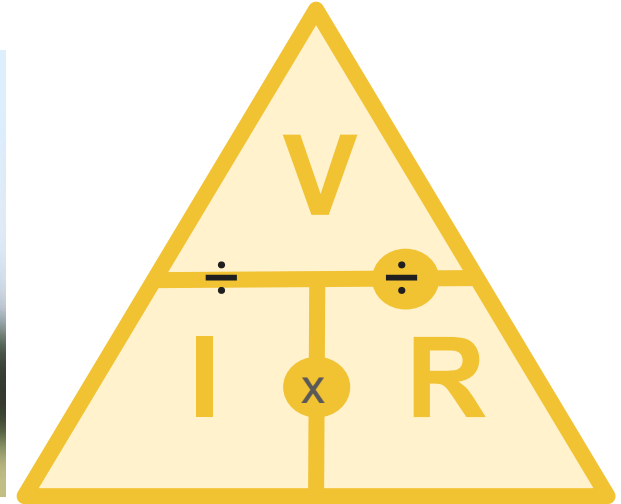
Practical Skills

How do we stay safe during a repair?
How do we approach a repair?



Social Context

Why is Right to Repair important?



Theory

What does it mean to design for repairability?

Questions?



THE UNIVERSITY OF BRITISH COLUMBIA

School of Engineering
Okanagan Campus