REPAIR CAFÉ TORONTO

Troubleshooting Workshop: for small appliances and other electrical devices

“My kettle is broken!”
“My clock doesn’t work!”
“It’s no good! – I’m throwing it out!”

Today:

First – A presentation guiding you through a general process of troubleshooting

Second - Some simple theory about electricity and how to use tools to measure electricity

Next - About safety when working with electricity

Finally - A practice session with your items so you can practice your new troubleshooting skills

What is Troubleshooting?

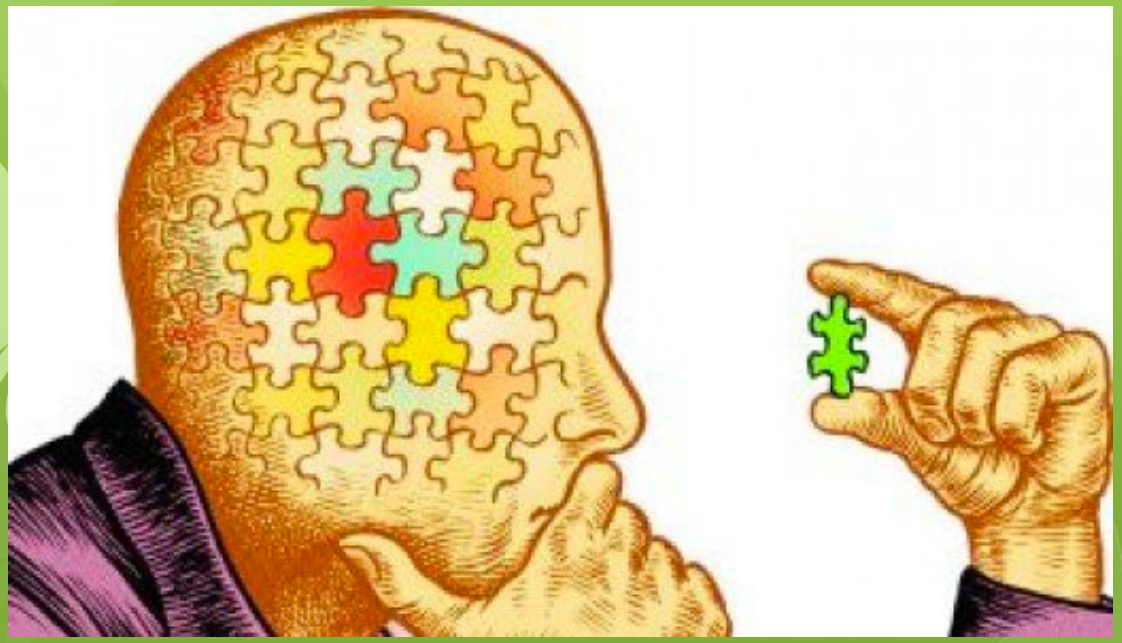
It is a form of problem solving, often applied to repair failed products or processes.

It is a logical, systematic search for the source of a problem so that it can be solved, and so the product or process can be made operational again.

- *Wikipedia*

A logical process means…

- Clearly describe the problem in detail.
- Try to create a block diagram of how the item works in very general terms.
- Use a step by step process of elimination.



Safety first!

- Be careful. Look before you Fix!
- Protect your eyes, hands and the people around you.
- Watch out for dangerous materials such as asbestos, chemicals or compressed gas.
- Avoid working on equipment that is plugged in, *unless* you have to make a measurement or do a live test.

Be aware of everything around you and how it is all connected!

Example: Fixing a Fan

Clearly describe the problem in detail:

The fan has four button type switches

One switch is **On / Off**

The other 3 are for the three speeds

Only the slow speed switch works all the time

Describe the Problem:

What exactly is the symptom or indication that it is not working?

When does this failure happen during the operation of the equipment?

Is there overheating of any part of the item?

Are there unusual sounds?

Are there unusual sequences of lights or other indicators?

Are there any error messages provided by the equipment?

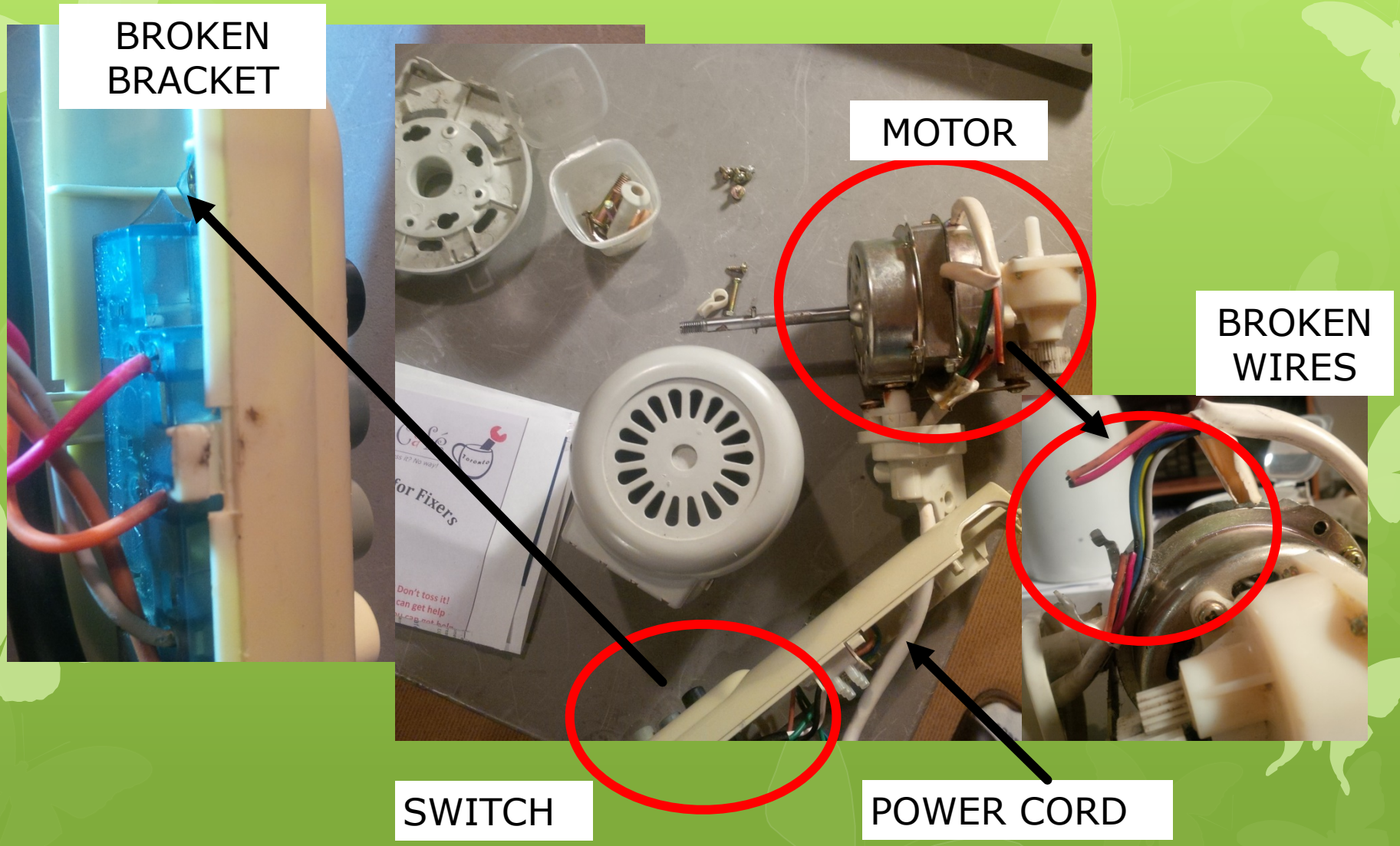
Tip: Always try to reproduce the problem to see if it is consistently failing and in the same way each time.

Block diagram of how a Fan works in general terms :

1. Power cord
2. Switches
3. Motor
4. Mechanical connection to fan

Follow a step by step process

What did I find?



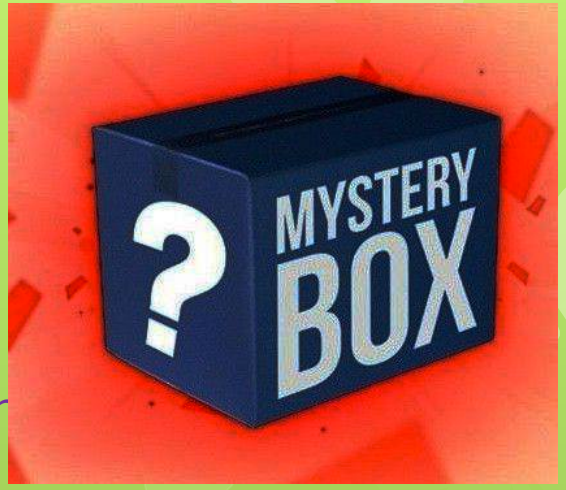
Step by step process of elimination

- Do one thing at a time
- Check the obvious first
  - Is the item being used properly? Read the manual if possible.
  - is it plugged in?
  - Is there a missing piece?
  - Is it properly connected and/ or assembled?
- Follow the flow of power or action
  - Is the power getting to the plug?
  - Is the key turning the gear?
- Do not skip a step or make assumptions.
- When trying various settings, only make one change at a time

Disassembly tip!

- Keep parts that you take off such as screws organized.
- Use an ice cube tray or egg carton to put the parts in sequence so you know what order to put them back.
- Write out the wiring layout as you go including the colour coding and any labelling you can see.

Manufacturer's Tricks - how do we get inside?



- Hidden screws.
  - Look under the feet
  - Look for mysterious circles in the plastic – they often hide screws
  - Look under labels
- Strange screws
  - Manufacturers are always coming up with new kinds of screws that require special screw drivers.
  - These are called security bits
- No screws
  - Sometimes the plastic case just snaps together
  - Sometimes the back is glued on

How do we defeat these tricks?

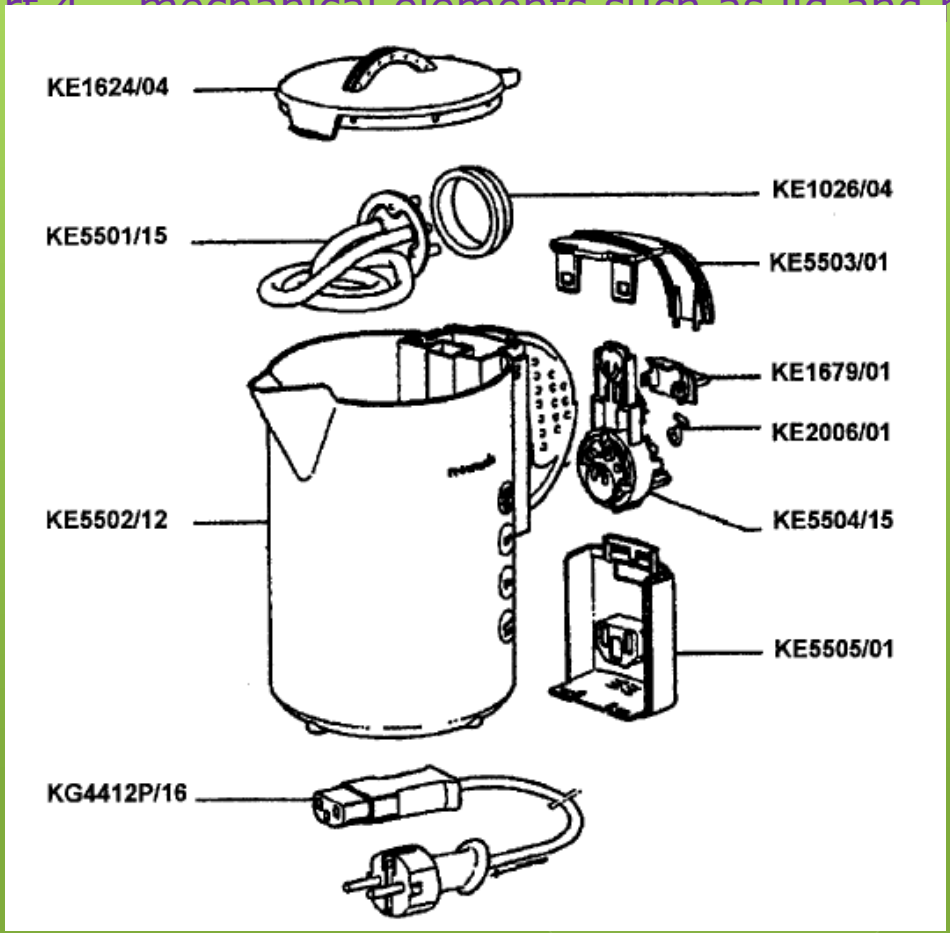
- Hidden screws – look over the whole body of the item carefully to find every screw
- Security bits – purchase a security bit screw driver set or borrow them from the Toronto Tool Library
- Can't find any screws? Look for seams in the plastic and carefully spread them apart with a flat head screw drivers or plastic spludger

HINT! – use YouTube. There are often videos people have posted shoeing you how to open things up. Search by make and model number or go to a website called iFixit.

Manufacturers manuals can be used in place of making a block diagram

Here's an example for a kettle:

- Part 1 – power cord and power connection
- Part 2 – switch and indicator light
- Part 3 – heating element
- Part 4 – mechanical elements such as lid and handle



What tools do you need?

The more variety of tools the better.
A basic toolbox:

- Tools for opening and taking apart
- Tools for testing
- Good light!
- Magnifying glasses and other visual aids are critical.
- Pen and paper


WÜRTH
Würth Bitset Universal, art. 0614 250 500
Y ADP
1/4x75mm
1/4x25mm
WÜRTH

Testing

- It is important to test every change you make to confirm whether it worked
- Always turn on and off the equipment after each step to find out if something has changed or not.
- Use test equipment such as an electrical meter or digital multimeter to check that there is power coming to the equipment or if a fuse is blown.
- It is important to have a plan of how you will be able to test an item before you start to troubleshoot. ie; do you have a CD or a set of headphones to test if something is working.

Using a Digital Multi Meter (DMM)

A DMM is a meter that can measure AC & DC voltage, current, resistance, capacitance and other electronic components.

Using a Digital Multi Meter (DMM)

V is for Voltage

R is for Resistance

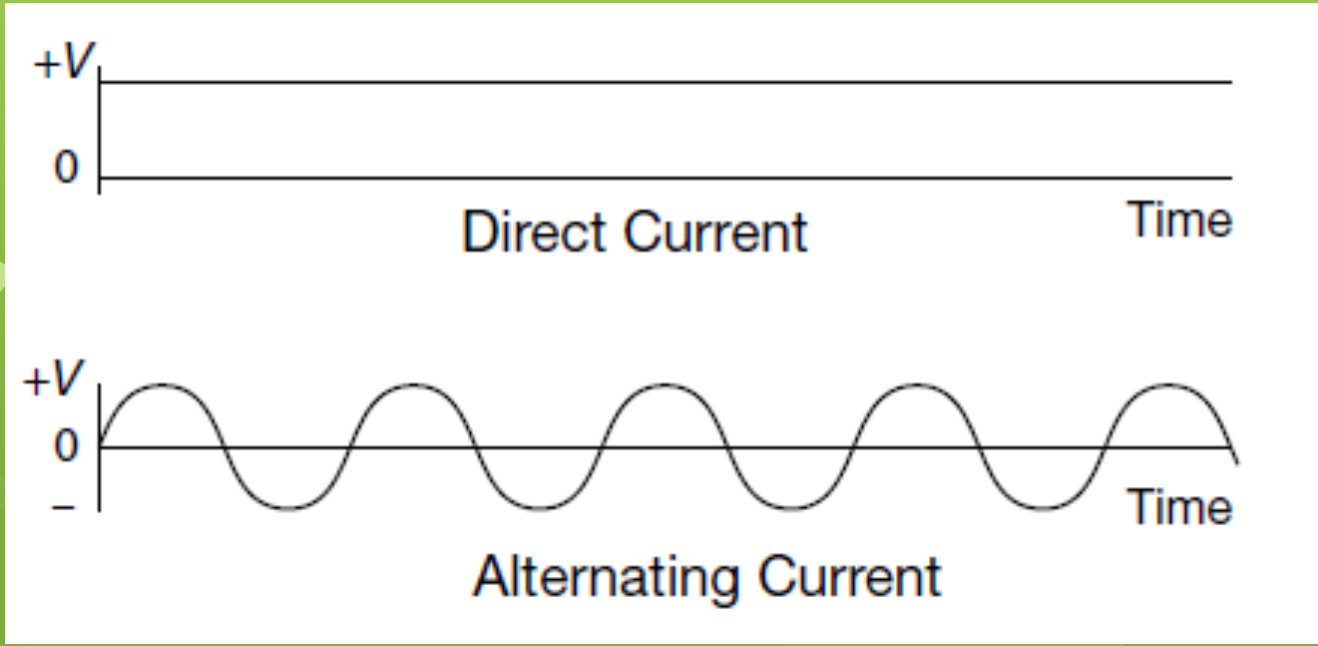
I is for Current

V - What is Voltage?

- Voltage is the force that pushes electricity (electrons) through a circuit.

- DC is what comes out of a battery or a power adapter. It is always positive +

- AC voltage is what comes out of most electrical sockets
  – generally alternating between +120V and -120V sixty times a second (60Hz).

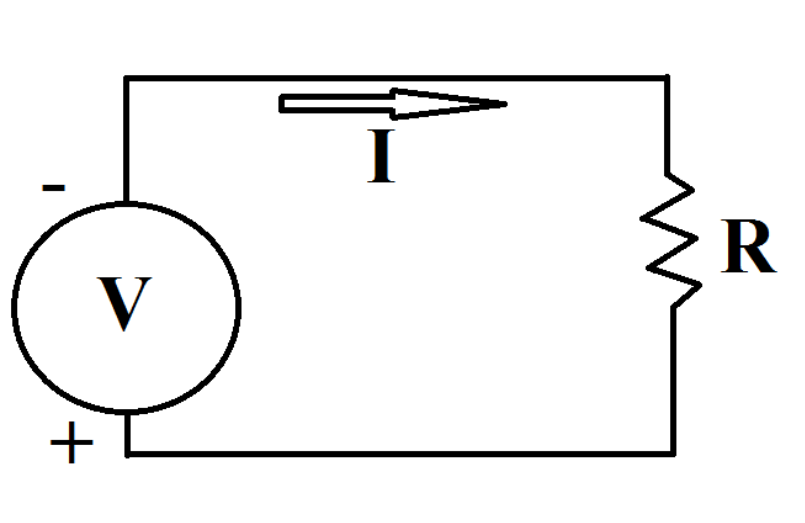


I - What is Current?

Current is the rate at which electrons flow when they are being pushed along by voltage. Current can be either AC or DC.

R - What is Resistance?

Resistance is the ability a material has to resist the force of voltage and slow down the flow of current.



Ohm's Law

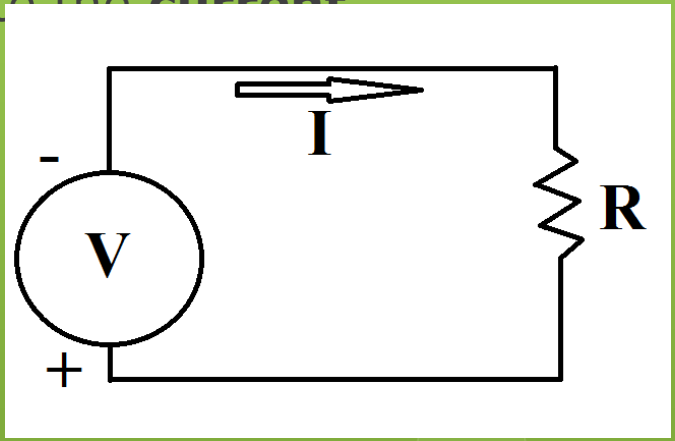
The relationship between the **I**, **V** and **R** of an electrical circuit is:

$$I = V/R$$

Usually we know or can measure the **voltage**.

We can measure the **resistance**.

Then we can calculate the **current**.



Why do we use a DMM?

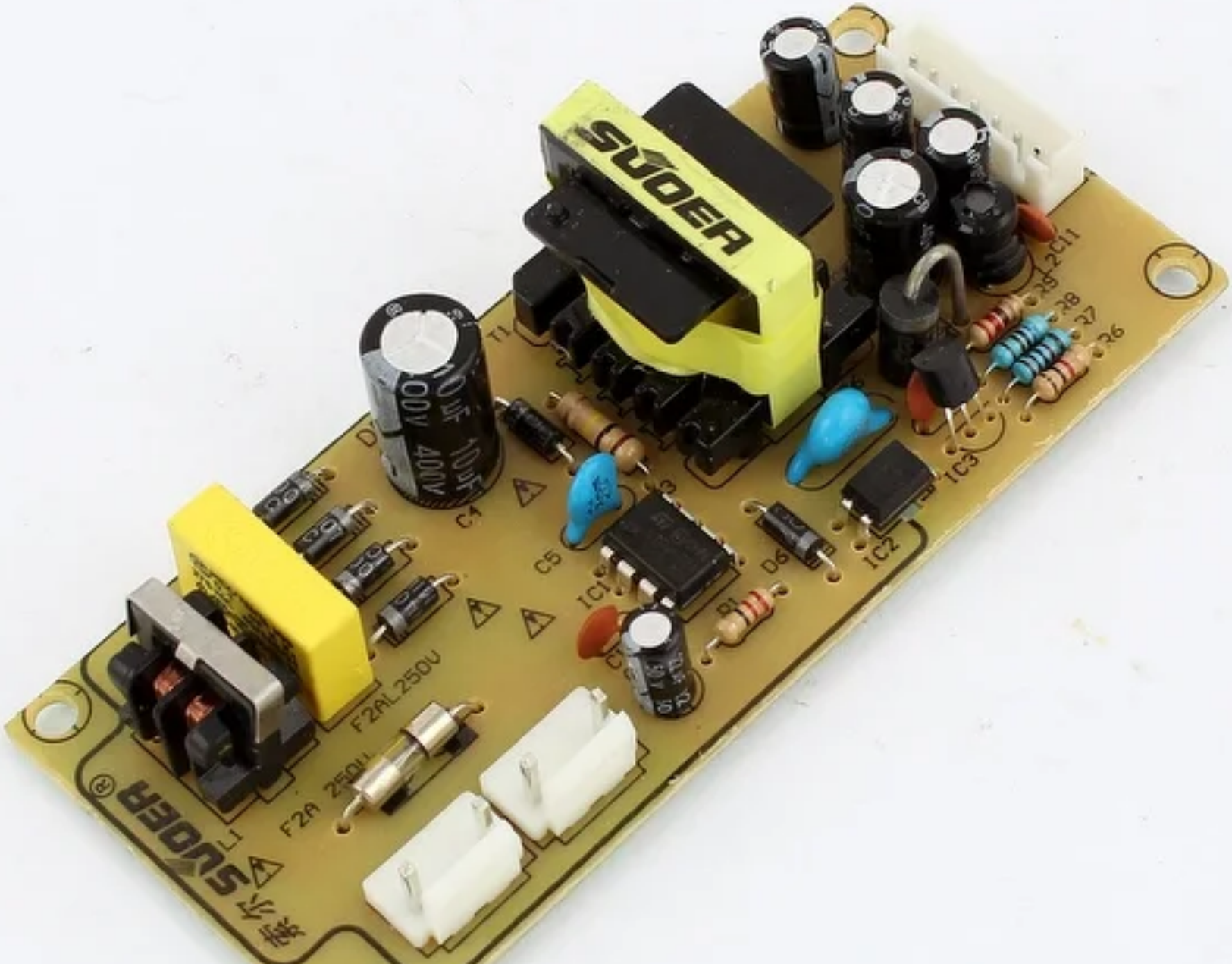
To measure **V** and **R**.

- We measure **V** to see if power is coming to the equipment.
- We measure **R** to see if there is a broken wire or broken component.
- Generally, we don’t need to measure **I**.

Caution! Measuring Voltage

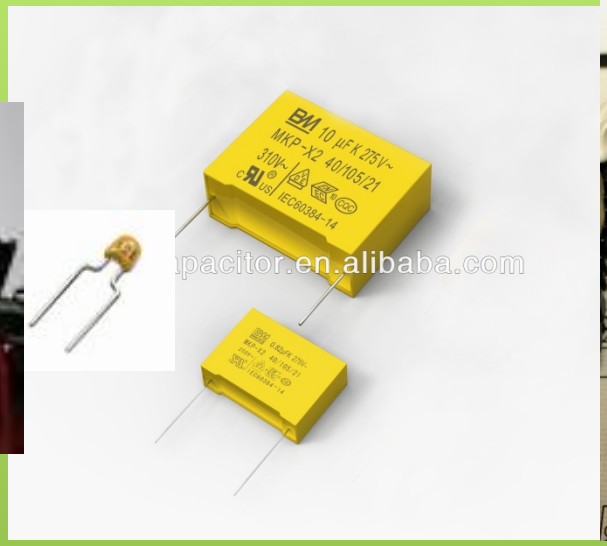
To measure voltage, the equipment under test is plugged in.

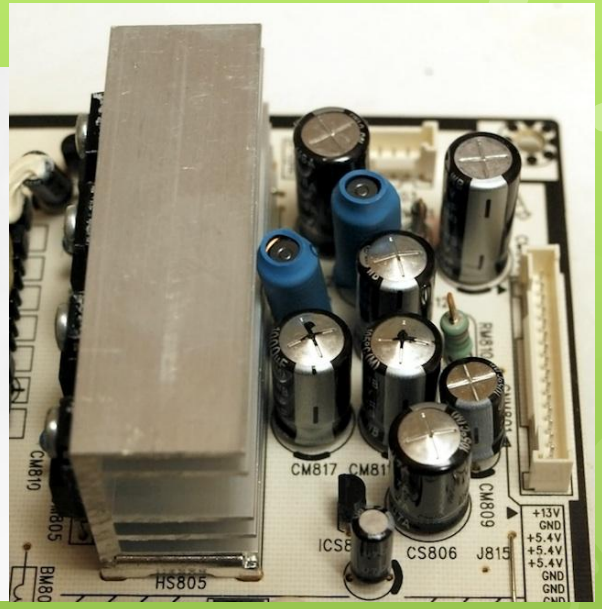
- **Voltage coming out of your outlet is very dangerous. Be careful measuring 120V.**
- **<u>Never</u> allow the two parts of the outlet or plug to be connected together.**
- **<u>Never</u> touch any electrical conductor directly with your hands.**
- **<u>Never</u> hold two ends of an electrical circuit with your bare hands.**


SUOER
T1
C4
10μF
400V
C5
IC1
IC2
IC3
D6
R1
R2
R3
R4
R5
R6
R7
R8
C11
F2AL250V
F2A 250V
L1
SUOER

Beware of Capacitors!

They come in many shapes and sizes





Be careful to discharge all stored power in capacitors in products such as:

- Tube TVs and monitors
- Camera flashes
- Older Microwave ovens
- Some amplifiers
- Electric motors

Other Resources

Use the internet to find:

- Manuals
- Parts
- Videos of repairs
- Experience and expertise of people who have had the same problem as you

Examples of repair websites:

www.ifixit.com

www.familyhandyman.com

www.parktool.com/blog/repair-help

Our public libraries have excellent repair books for specific types of items (including online manuals)

e.g. Technical Publishing (schematics) at www.torontopubliclibrary.ca/detail.jsp?Entt=RDMEDB0170&R=EDB0170

Let’s try troubleshooting!

Have Fun!