

# Lab 1 Tutorial

- Heat sink intro

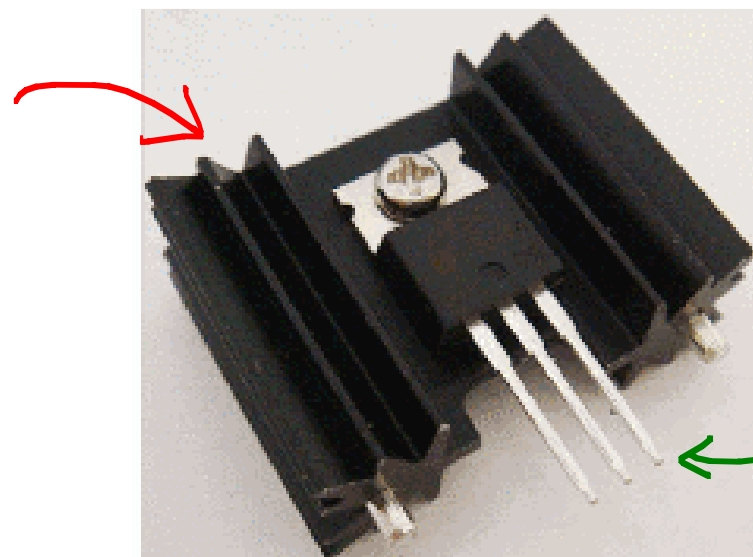
Q: What limits the performance of an electronic device?

A: often limited by **HEAT**

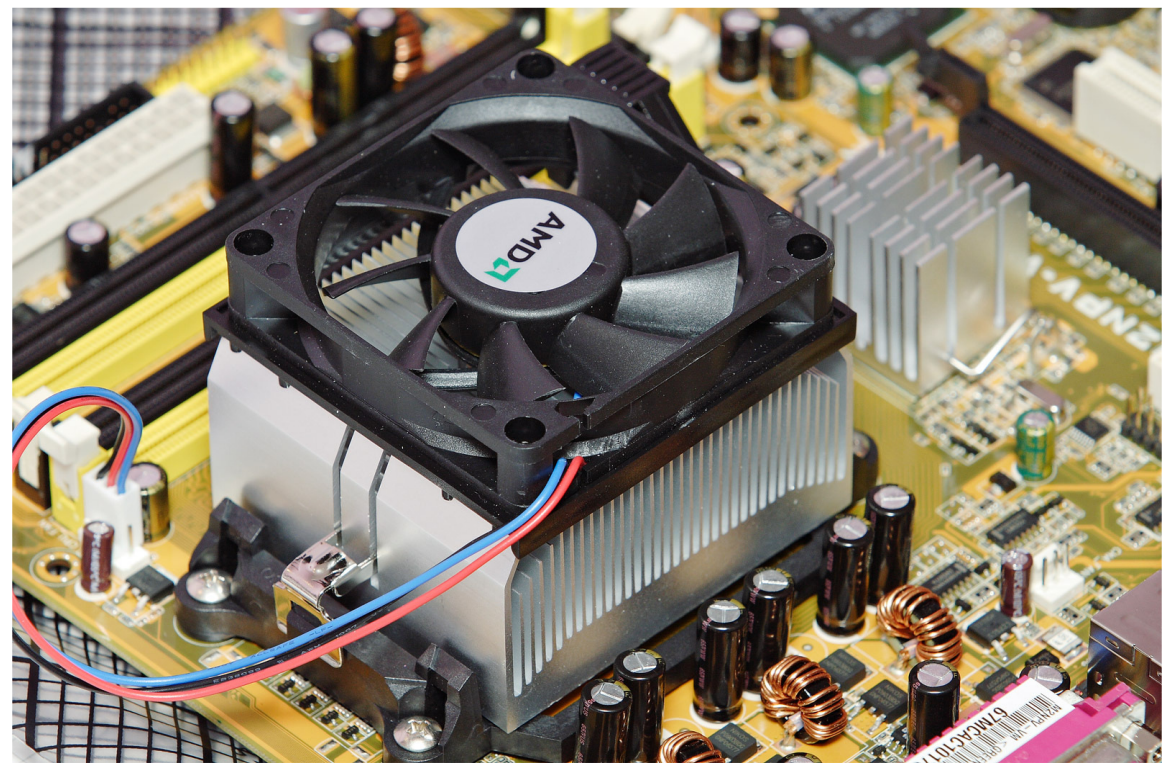
Thermal management is VERY important for many applications!

- ① Heat sinks
  - ② Forced air
  - ③ Liquid coolant
- “Active” cooling

Heat sink

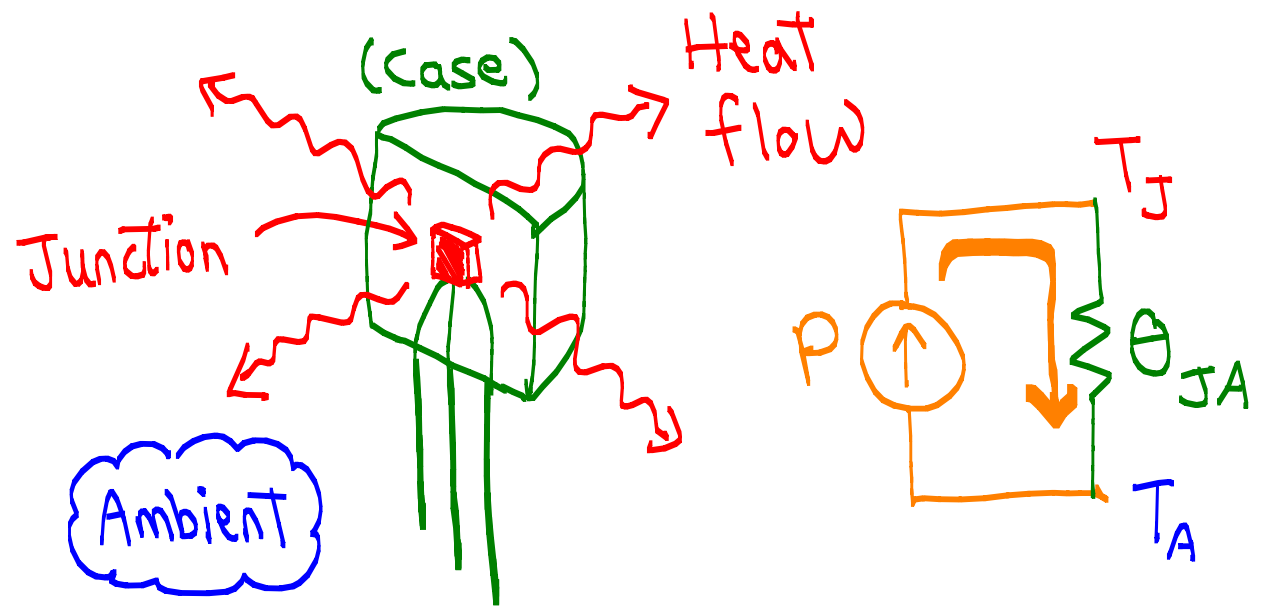


Transistor

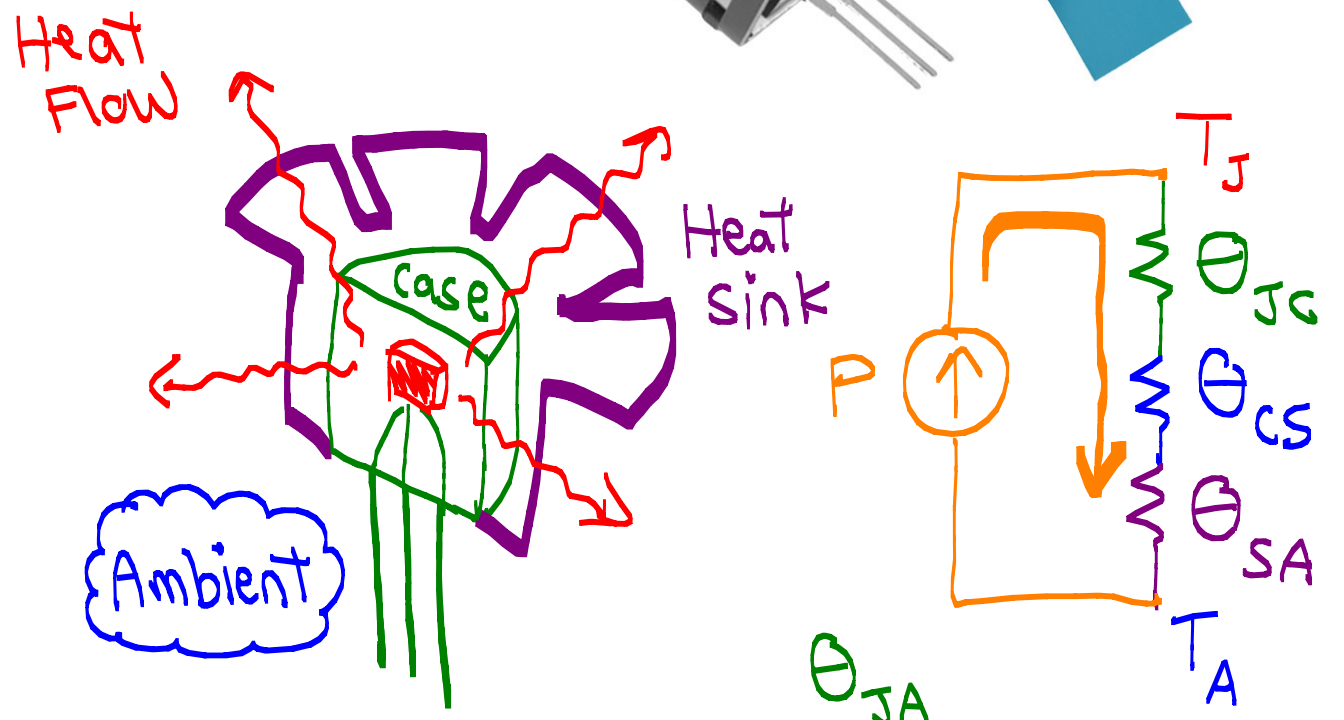


# Heat Sink Formulas

NO heat sink



WITH heat sink

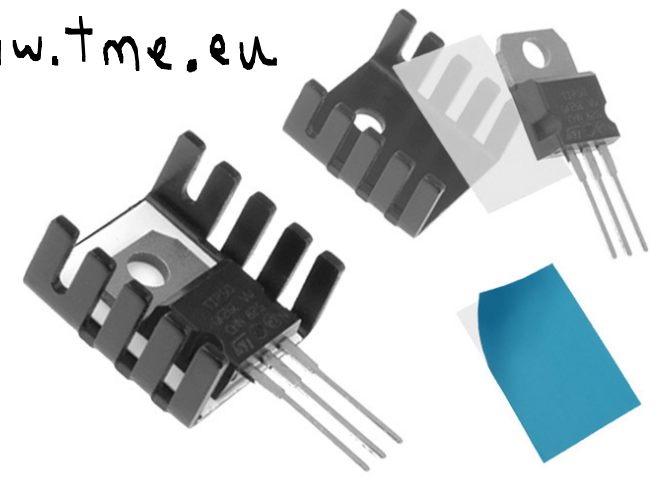


$$T_J = T_A + P \times [\Theta_{JC} + \Theta_{CA}]$$

$\Theta_{JA}$   
↑ Junction to case  
↑ case to Ambient

$$T_J = T_A + P \times [\Theta_{JC} + \Theta_{CS} + \Theta_{SA}]$$

$\Theta_{JA}$   
↑ Junction to case  
↑ Case to sink  
↑ sink to Ambient



• Transistor Packages ← This course typically uses "Through hole" type (13)

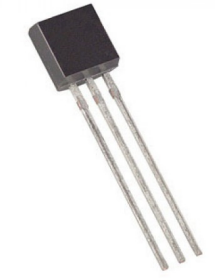
Some common types... <sup>No</sup> heat sink →

$\theta_{JA}$

$\theta_{JC}$

use with heat sink

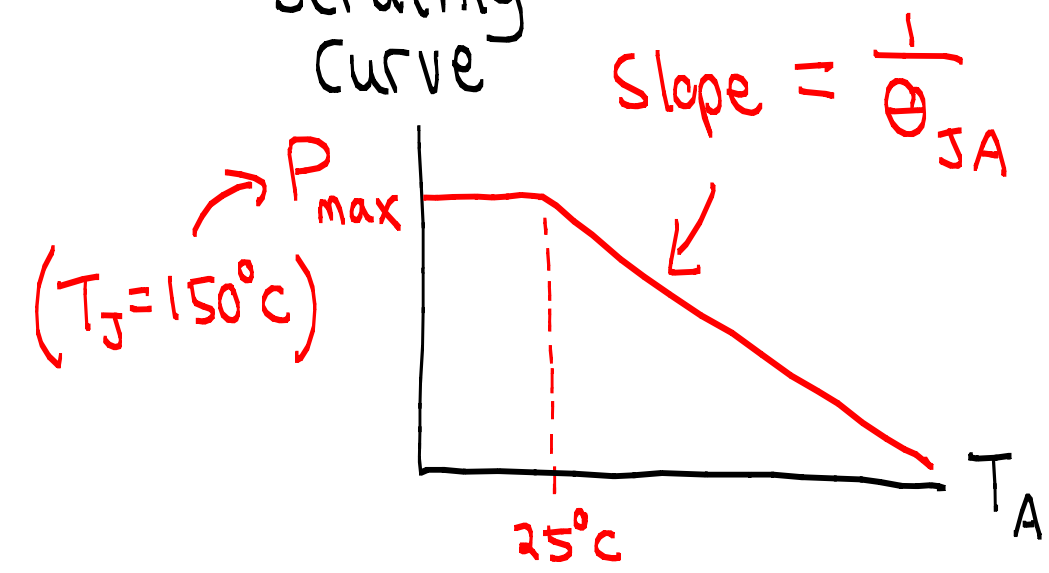
• TO-92  
e.g. 2N3904



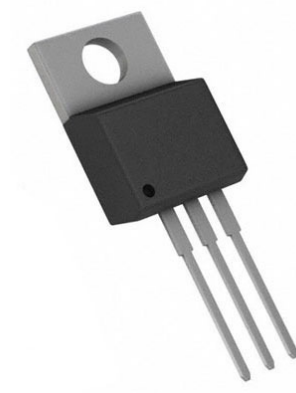
$200\text{ }^{\circ}\text{C}/\text{W}$

$83.3\text{ }^{\circ}\text{C}/\text{W}$

Derating Curve



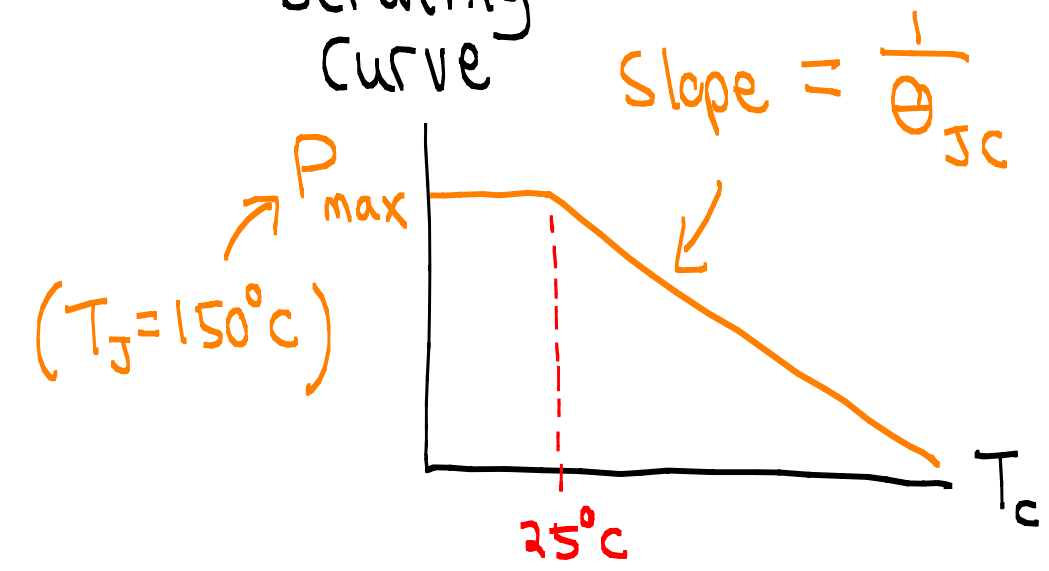
• TO-220  
e.g. TIP31



$62.5\text{ }^{\circ}\text{C}/\text{W}$

$3.125\text{ }^{\circ}\text{C}/\text{W}$

Derating Curve

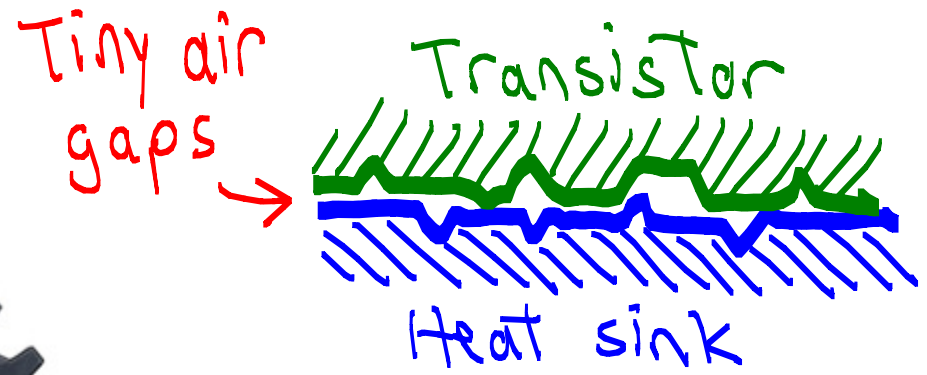
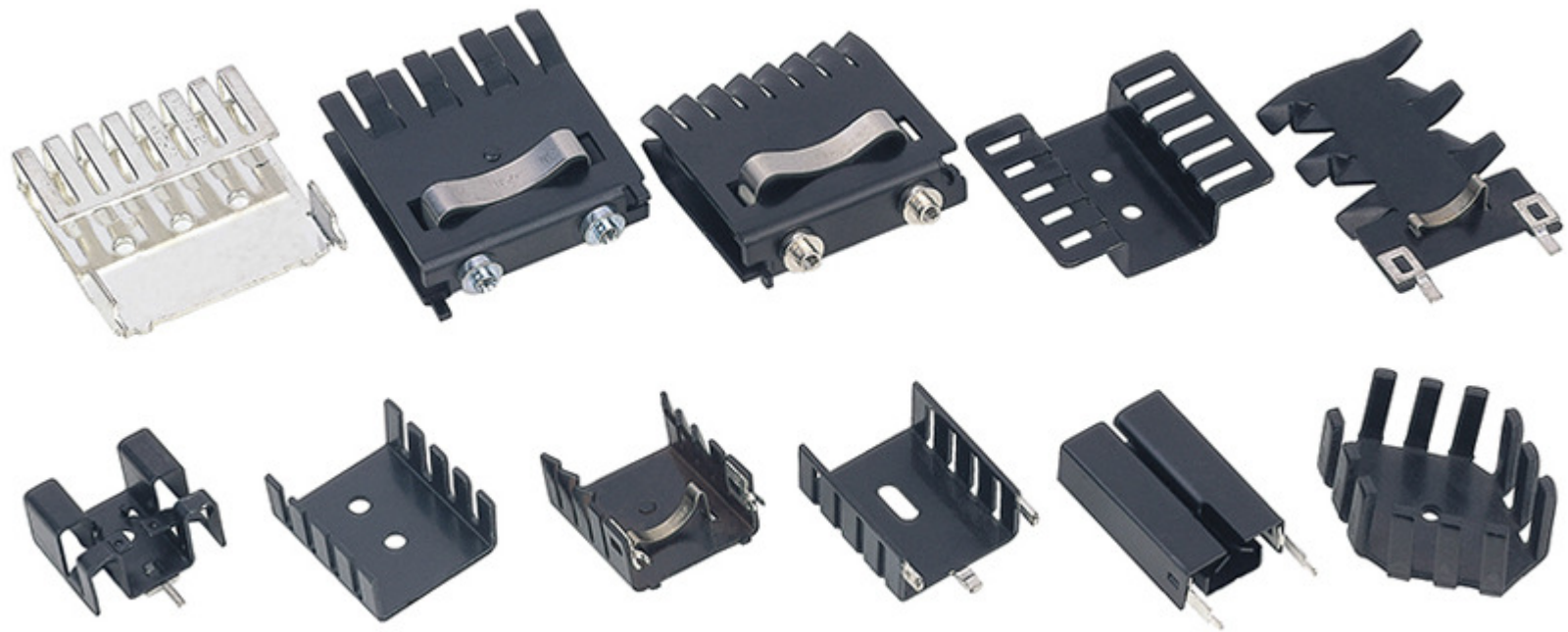


• TO-3  
e.g. 2N3055



$1.52\text{ }^{\circ}\text{C}/\text{W}$

• Many types of heat sinks...



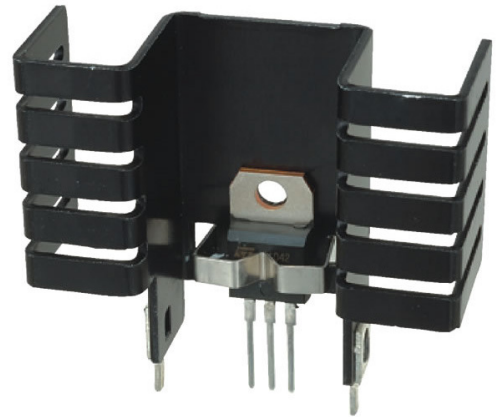
Thermal paste



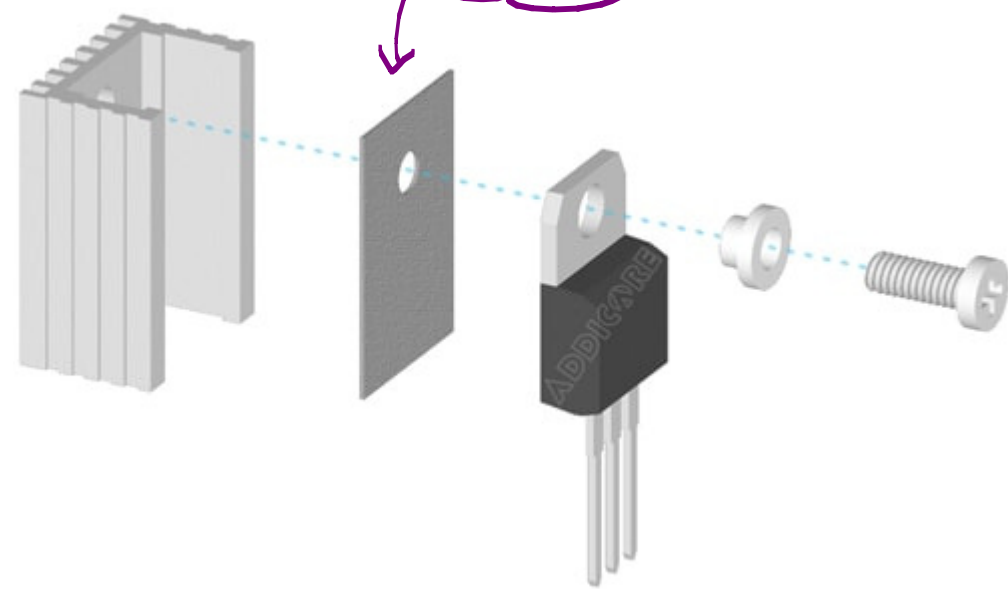
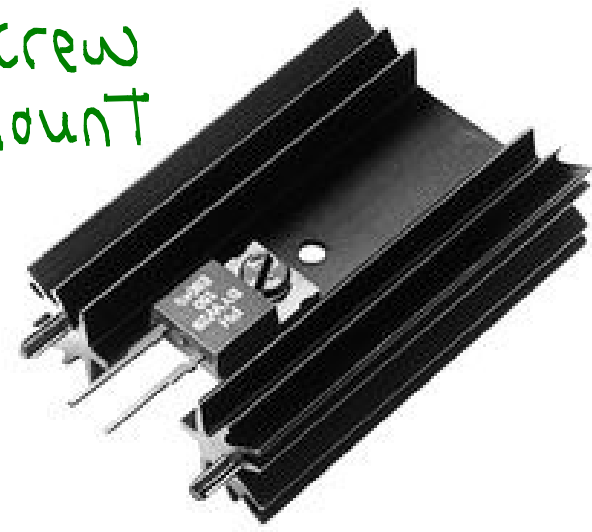
OR

Thermal pad

Clip Mount



Screw mount

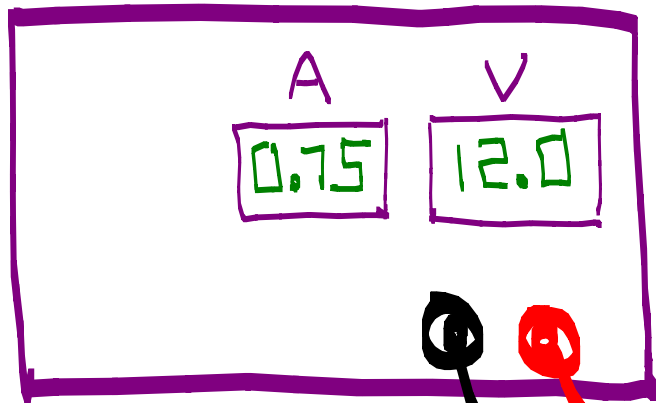


• Today's Lab

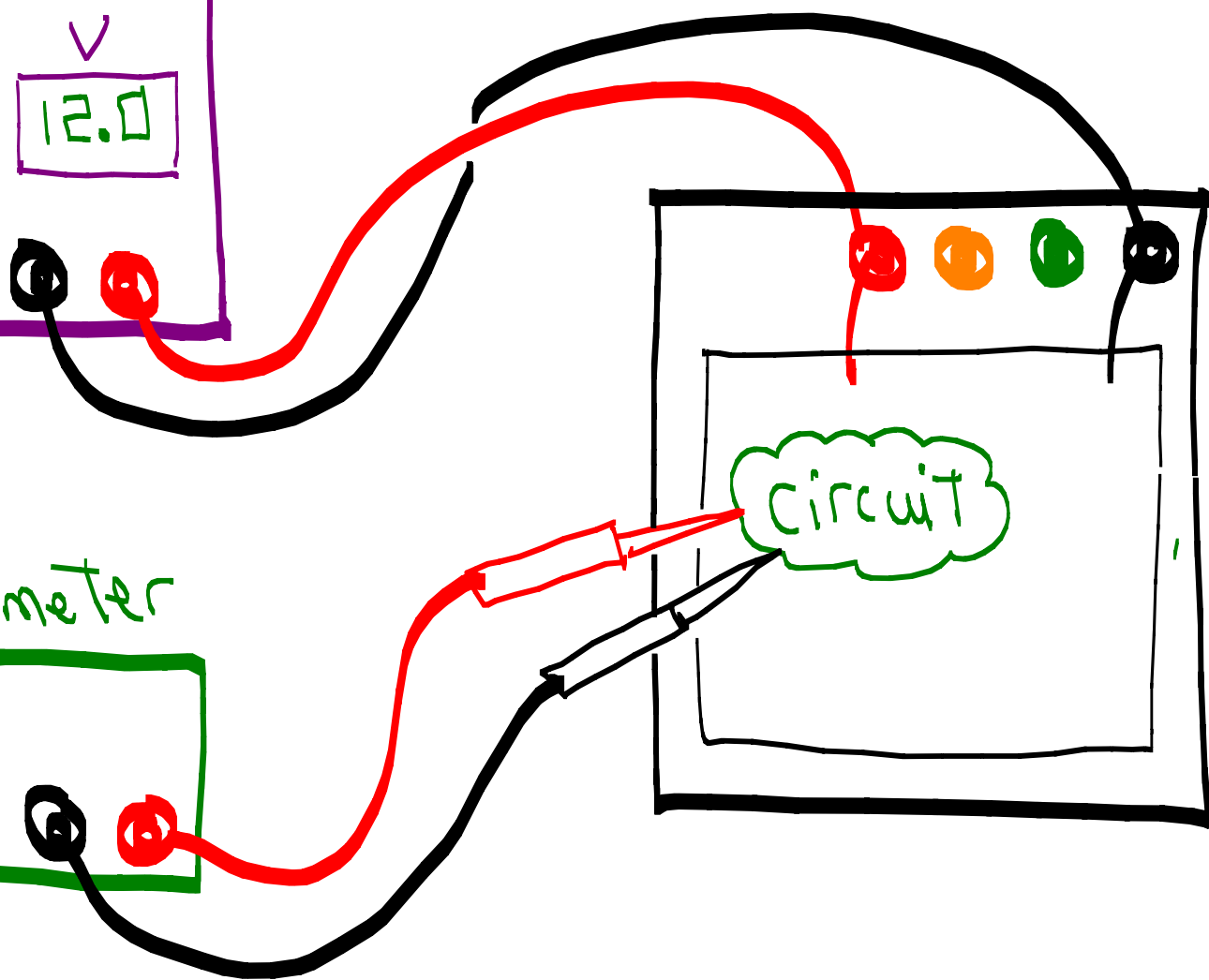
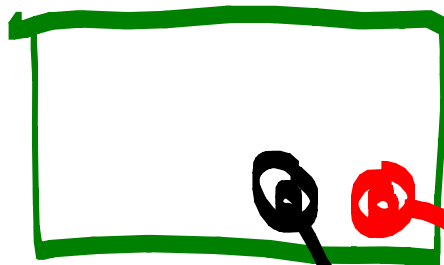
(1) Heat Sink : Calculations

Attach to transistor

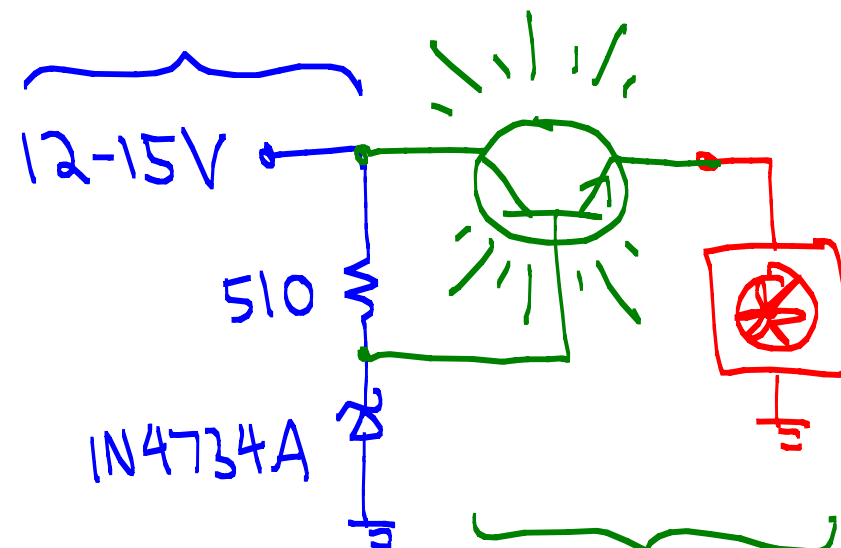
Benchtop Supply



Multimeter



(2) Zener



(3) Follower