

# Basics of electronics and embedded systems

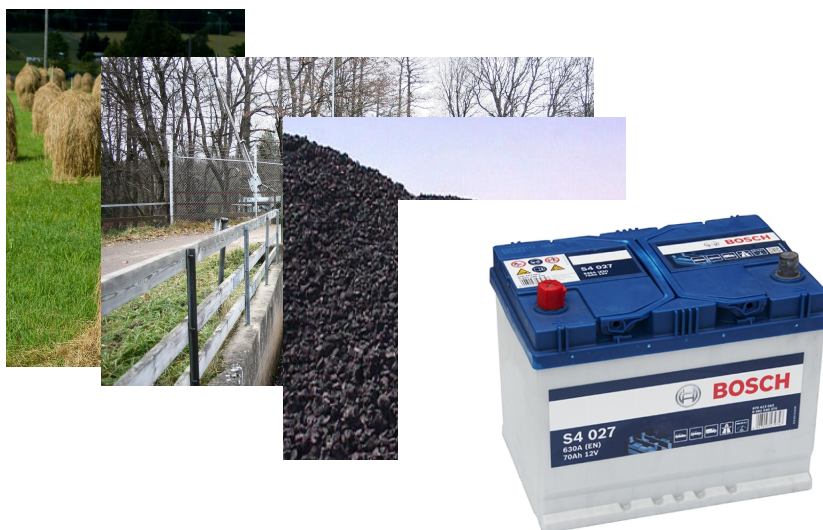
Anders J Johansson  
2018

## Why electricity?

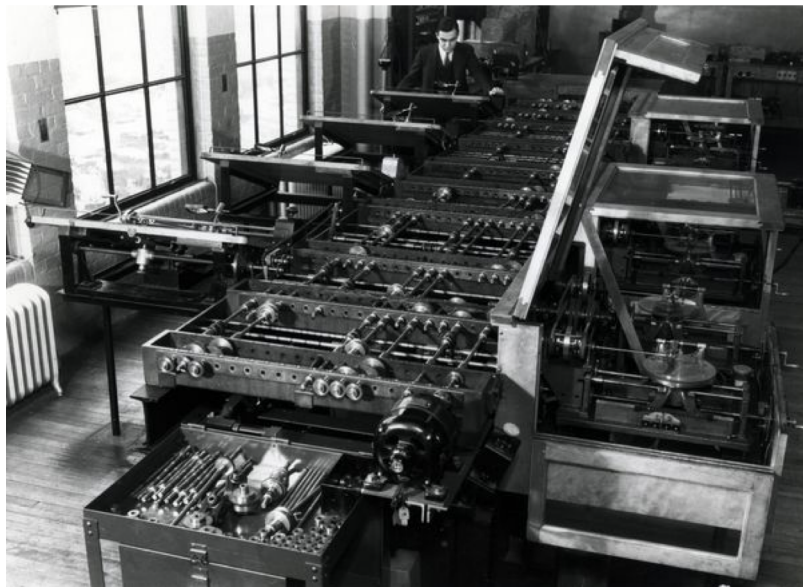
## Move energy efficiently



## Store energy conveniently



## Move information efficiently



## Planimeter

Measures area using wheels and cogs.



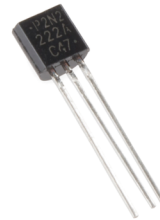
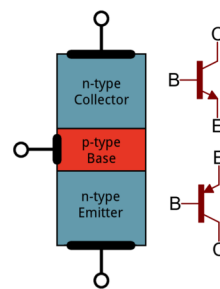
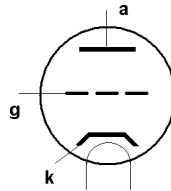
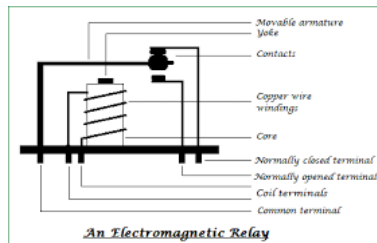
## What is electronics?

- How to build a function.
  - Physical implementation of mathematics.

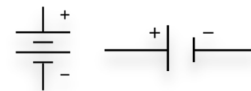


- To solve a task
  - Automation, measurement, light, sound, recording...

## Evolution of controlled devices



## Battery



- Gives a certain voltage (idealisation)
- One-time use or rechargeable
- Has an internal resistance



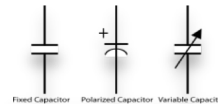
## Resistor



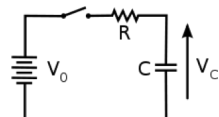
- Follows Ohms law
  - $U=R*I$
- The power becomes heat
  - $P=U*I$



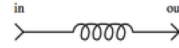
## Capacitor



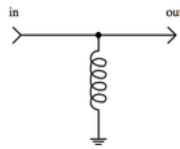
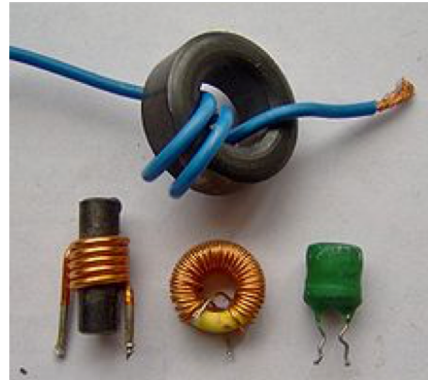
- Stores energy between two plates as an electrical field
- $C=Q/V$
- $I(t)=C*dV(t)/dt$
- Often used as a filter



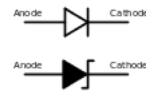
## Inductor



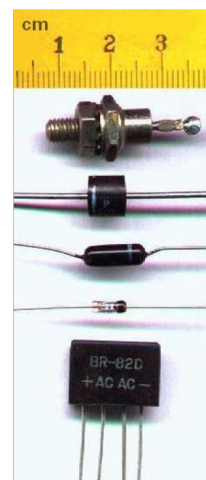
- Is usually a coil of wire
- Generates a magnetic field
- Stores energy in the magnetic field
- Often used as a filter



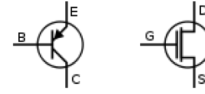
## Diode



- Is a one-way valve for electric current
- Used for restricting flow of current, AC-to-DC conversion
- Also used to generate a fixed voltage reference



## Transistor



- Is a electrically controllable valve or switch
- Used for amplification of weak signals
- Used as a logic gate for digital electronics, including computers



## Light bulb



- Has a certain power in watts at a certain voltage.
- Works as a resistor.
- Gives off more heat than light.

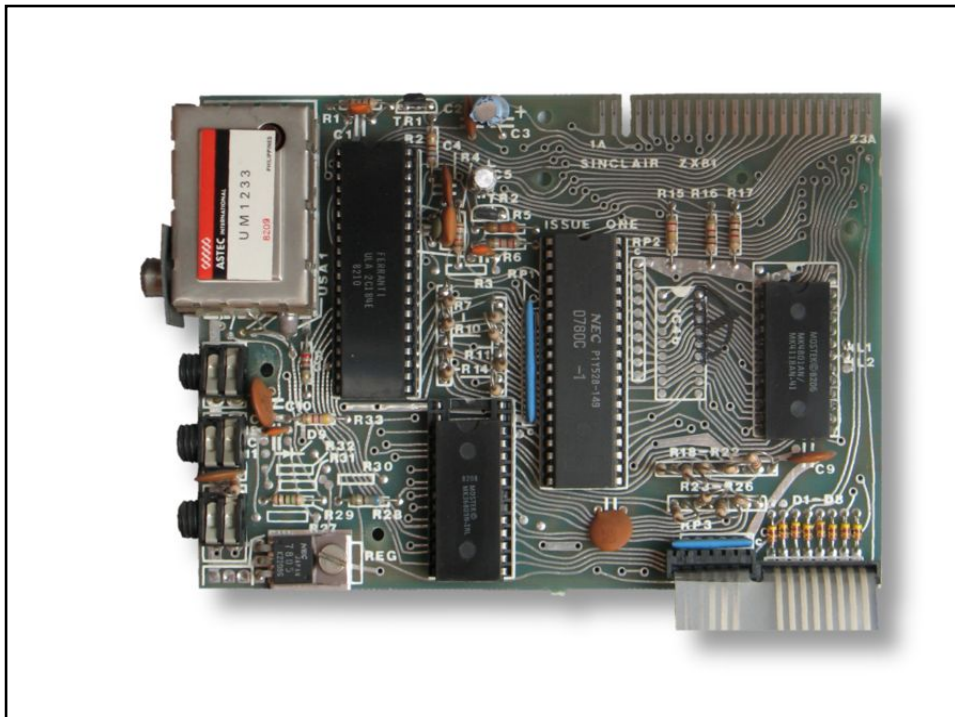
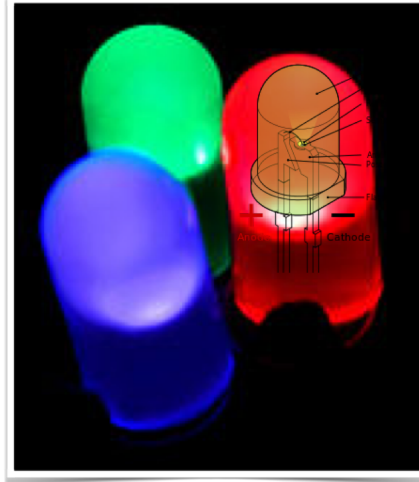




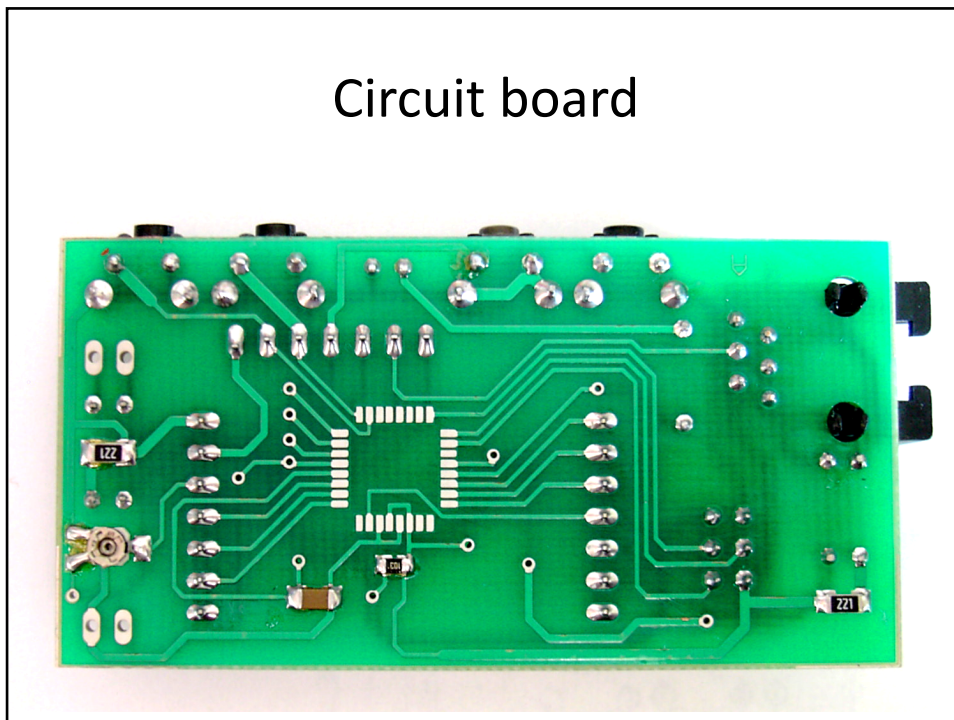
# LED



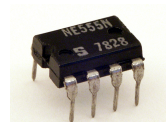
- Is a semiconductor
  - Must be connected in the right direction
  - Does not follow Ohms law directly!
- Voltage drop = 1.6 - 4V
- Must have a resistor in series not to break!
  - (Sometimes the internal resistance in a battery is sufficient.)



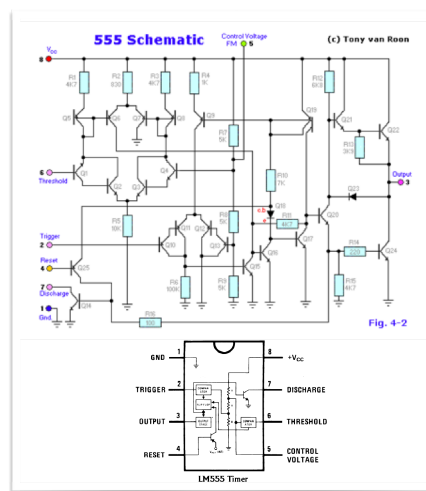
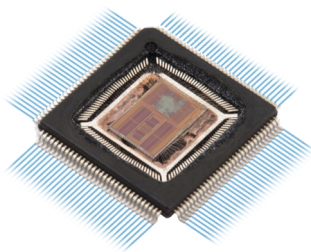
## Circuit board



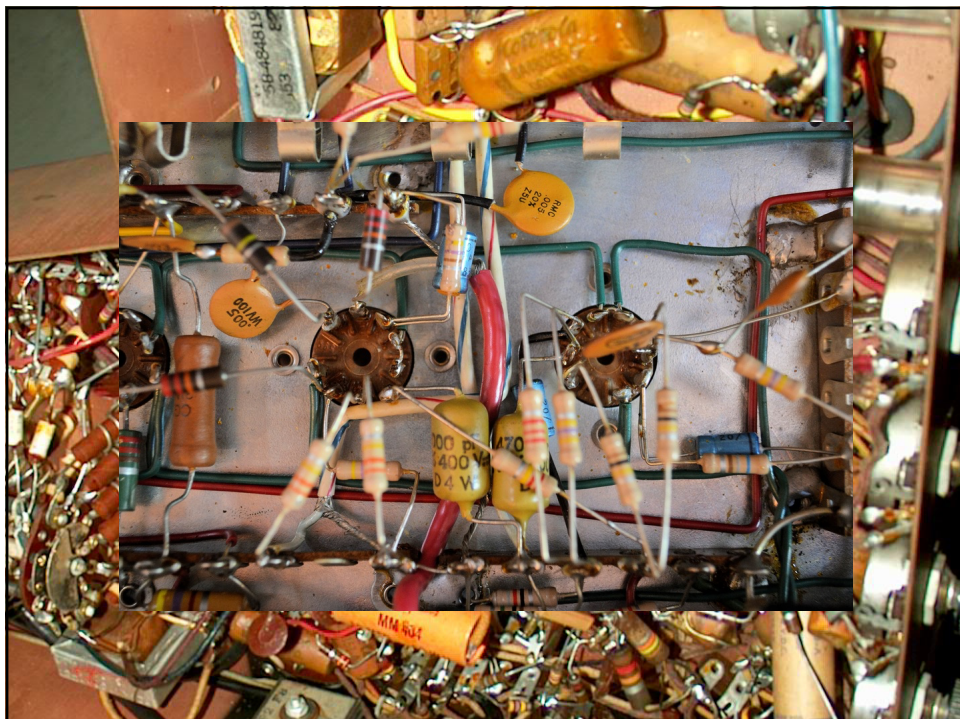
## Integrerad krets



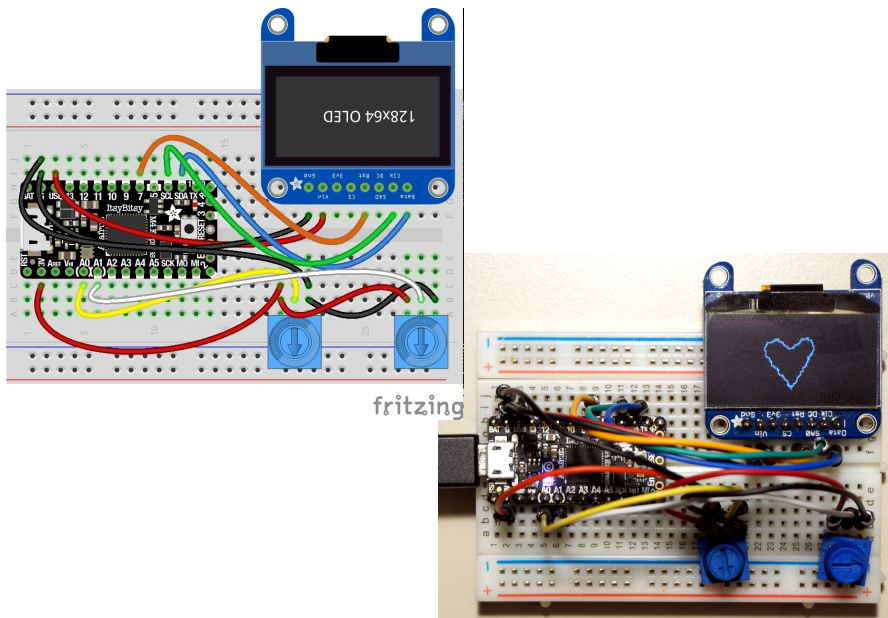
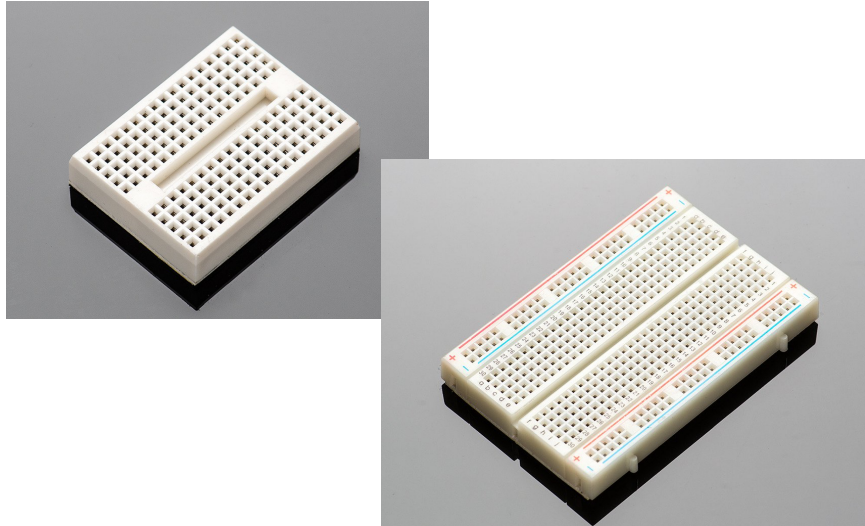
- Kallas även IC-krets
- Innehåller flera komponenter som är ihopkopplade med varandra.
- Finns både analoga, digitala och kombinerade.



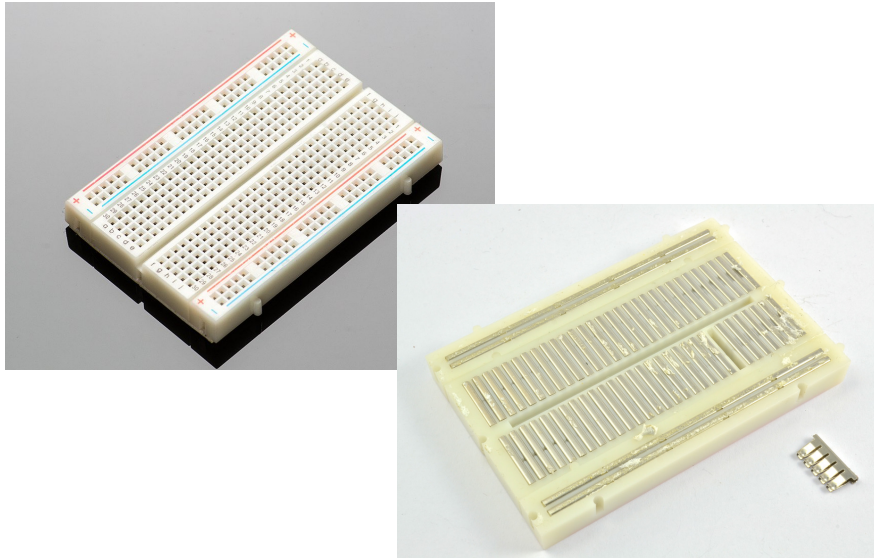
# Raspberry Pi



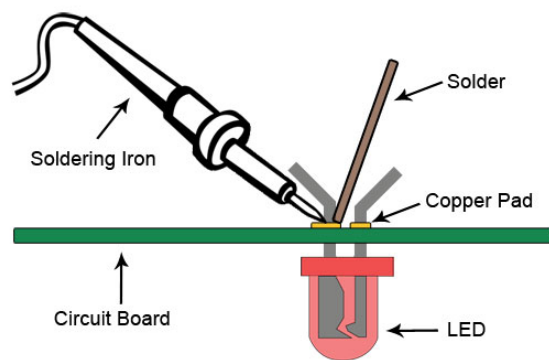
# Bread board



## Breadboard inside



## How to solder



Makerspaces.com/how-to-solder/

<https://www.makerspaces.com/how-to-solder/>