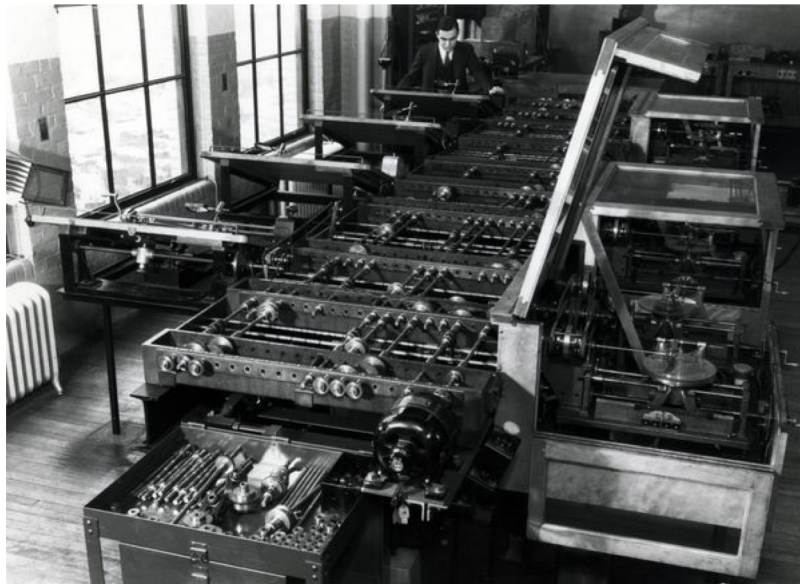


Basics of electronics and embedded systems

Anders J Johansson
2018



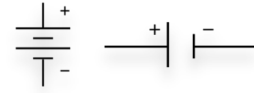
“Laws”

- Kirchoffs current law
 - The sum of currents in a node is zero
- Kirchoffs voltage law
 - The sum of voltages in a loop is zero
- Ohms law
 - $U=R*I$ ([Volt]=[Ohm]*[Ampere])
- Power law
 - $P=U*I$ ([Watt]=[Volt]*[Ampere])

Flashlight

What do we need?

Battery



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



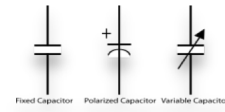
Resistor



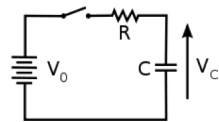
- Follows Ohms law
 - $U=R \cdot I$
- The power becomes heat
 - $P=U \cdot I$



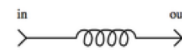
Capacitor



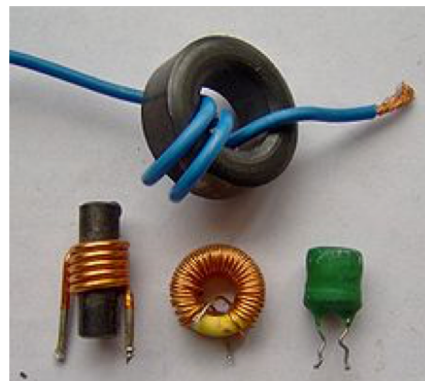
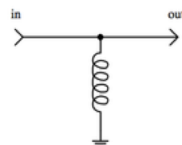
- Stores energy between two plates as an electrical field
- $C=Q/V$
- $I(t)=C*dV(t)/dt$
- Often used as a filter



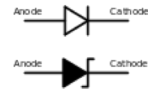
Inductor



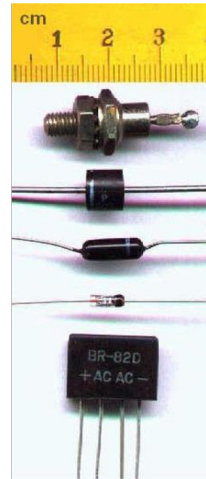
- Is usually a coil of wire
- Generates a magnetic field
- Stores energy in the magnetic field
- Often used as a filter



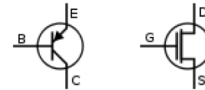
Diode



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



Light bulb



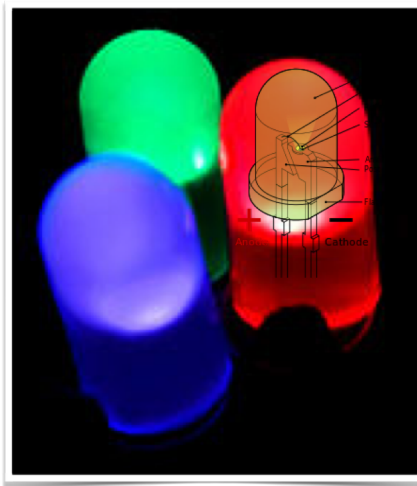
- Has a certain power i W at a certain voltage
- Works as a resistor
- Gives off more heat than light



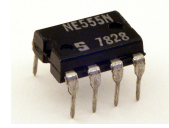
LED



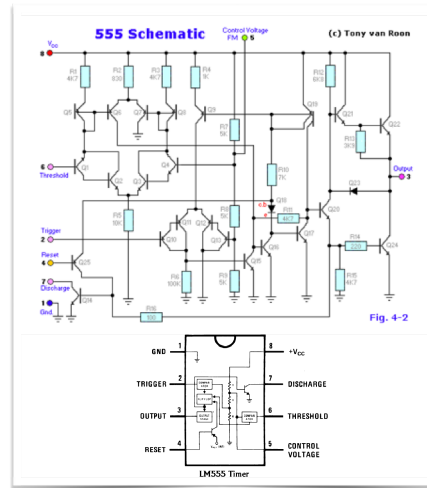
- Is a semiconductor
 - Must be connected in the right direction
 - Does not follow Ohms law directly!
- $V_d = 1.6 - 4V$
- Must have a resistor in series not to break!
 - (Sometimes the internal resistance in a battery is sufficient.)



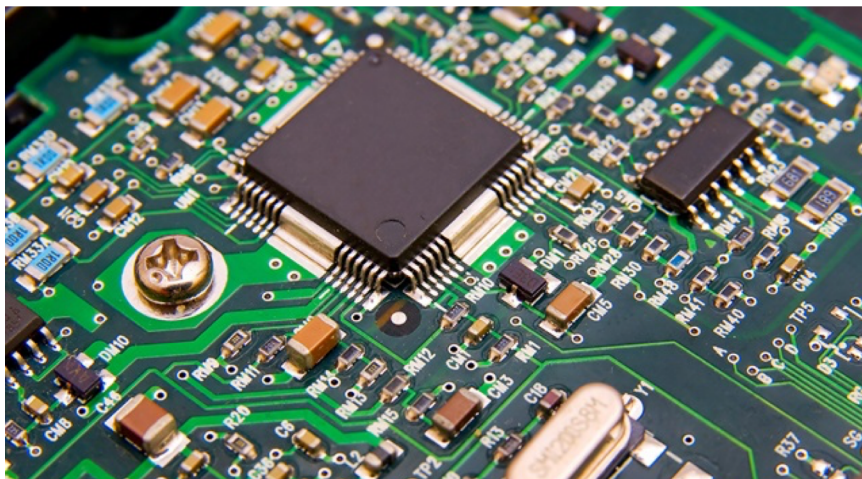
Integrerad krets



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



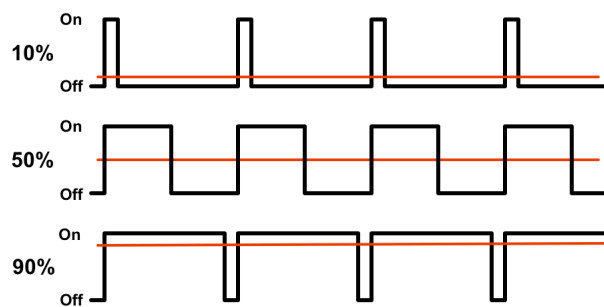
Microcontroller



Controlling light

- Brightness
- Colour

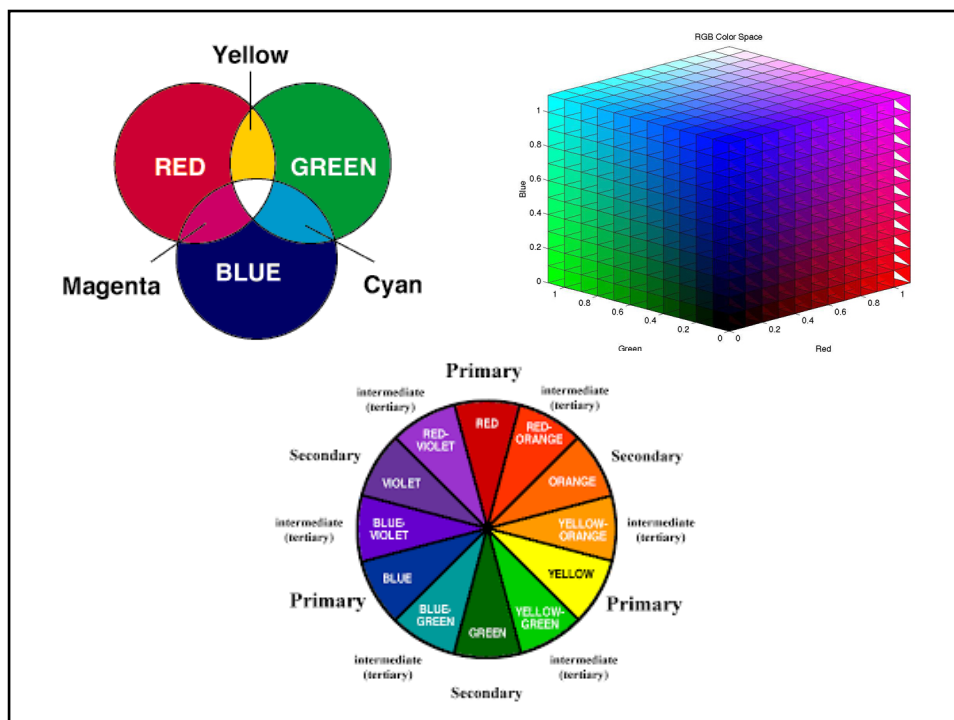
Pulse Width Modulation



What is colour?

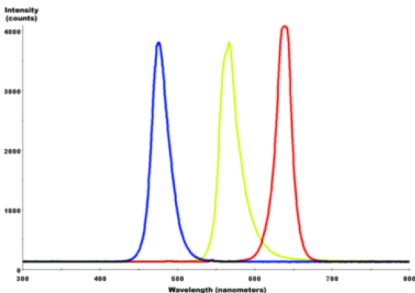
- "The property possessed by an object of producing different sensations on the eye as a result of the way it reflects or emits light."

"Point is, **light** comes in a lot of different wavelengths, but which wavelengths correspond to which color, or which can even be seen, depends entirely on the eyes of the creature doing the looking, and not really on any property of the **light** itself. There isn't any objective "real" color in the world."

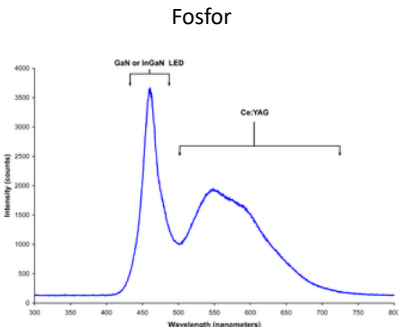




Spektrum för vita lysdioder

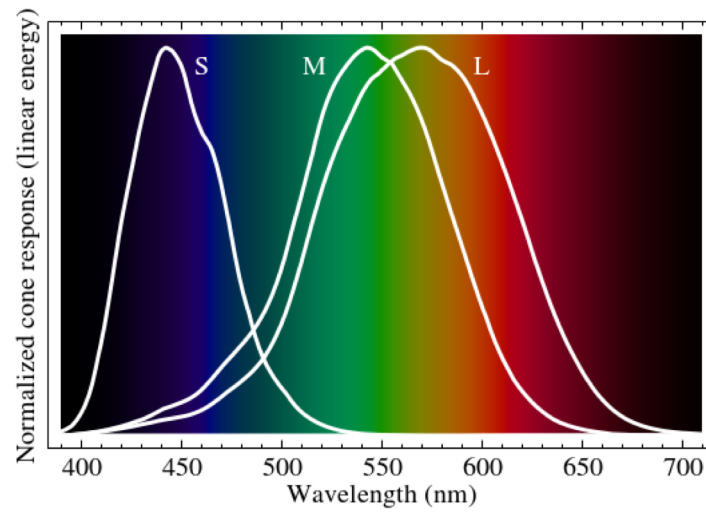


RGB



Fosfor

Normalised human cone responses



Relative brightness sensitivity

