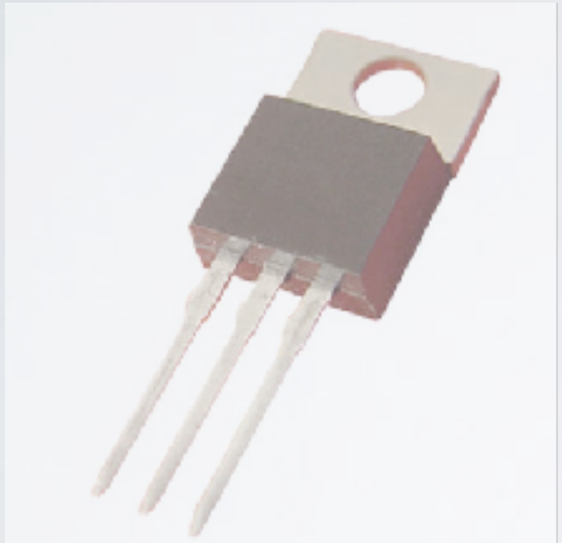
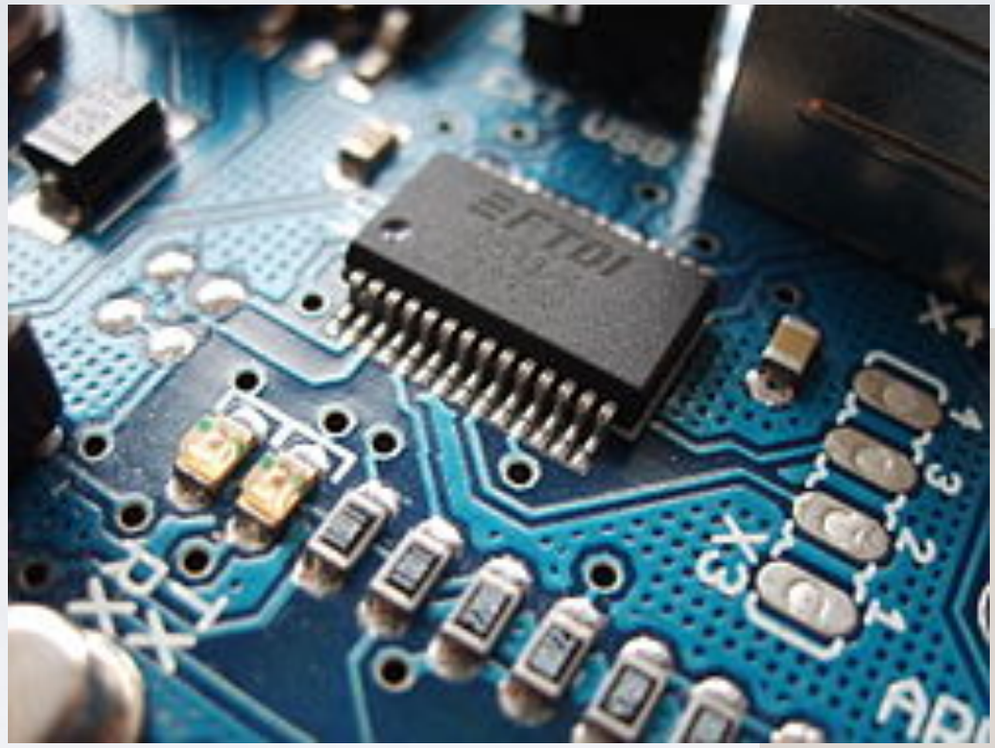
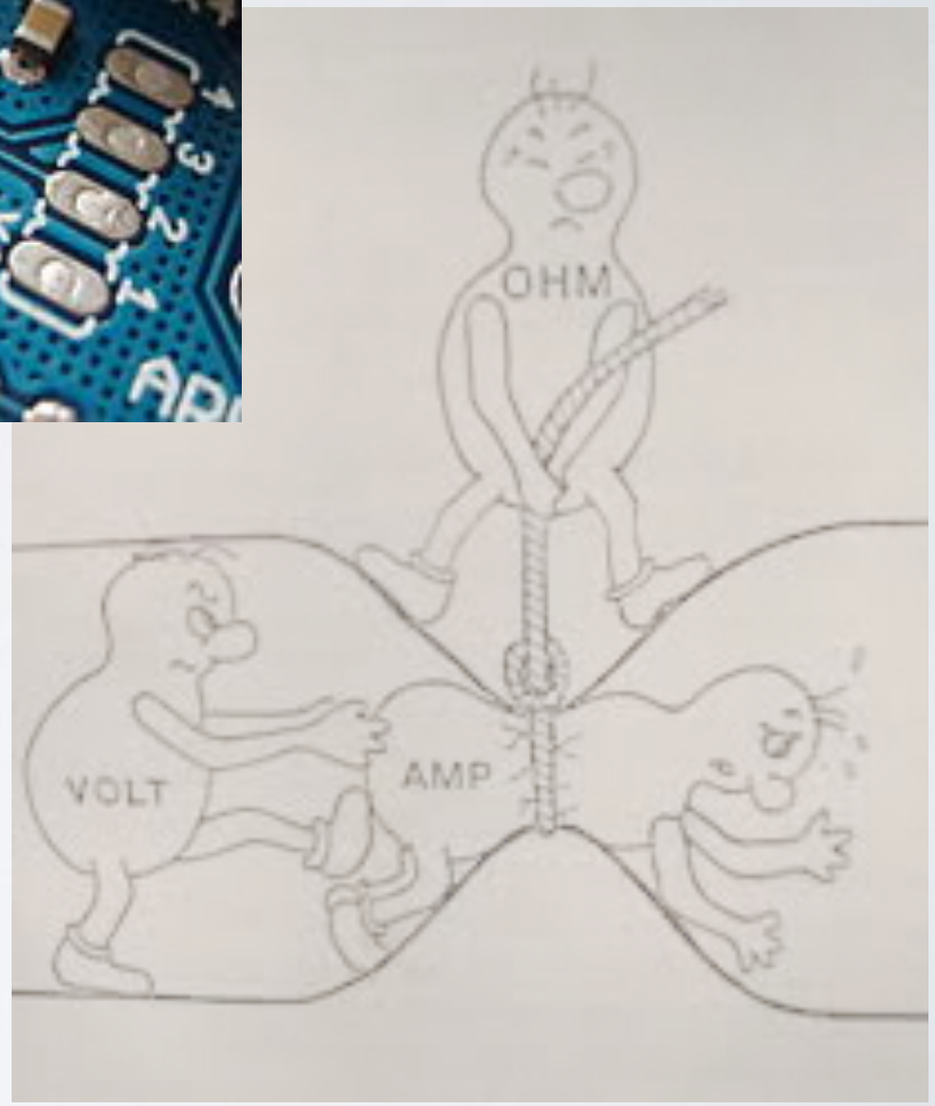




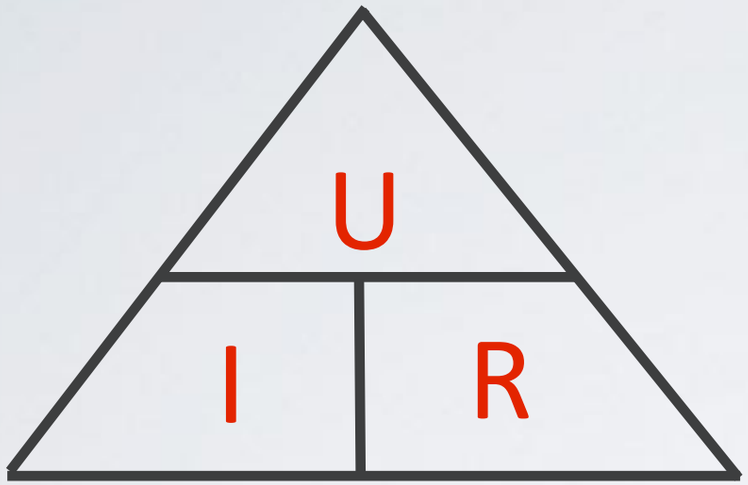




Introduction to Electronics
Artscience BA1 2020-2021
Part II

# Ohm's Law:

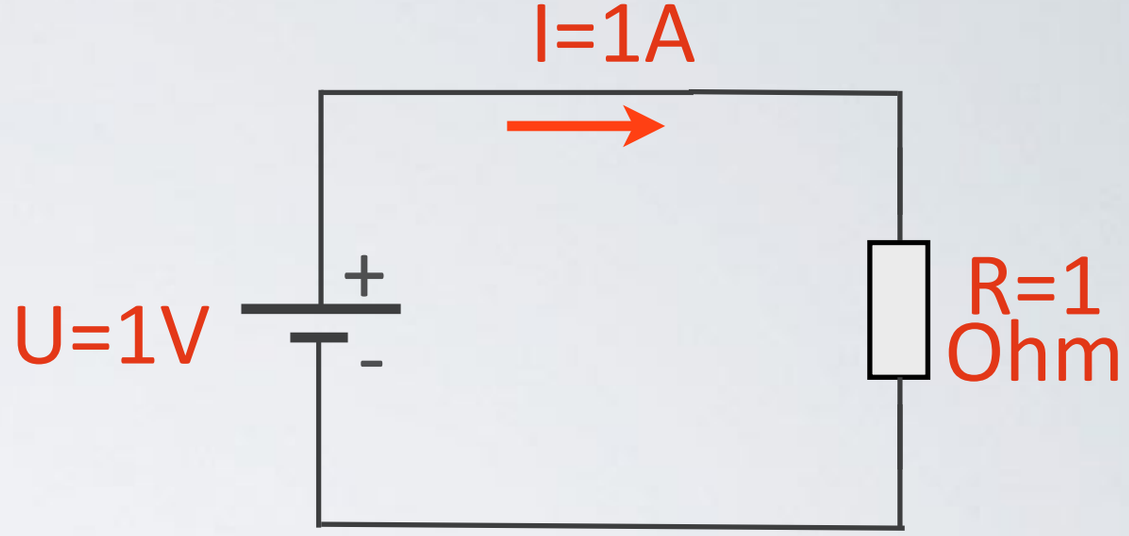
$U = I * R$

(Volt)




$I = \frac{U}{R}$ (Ampere)

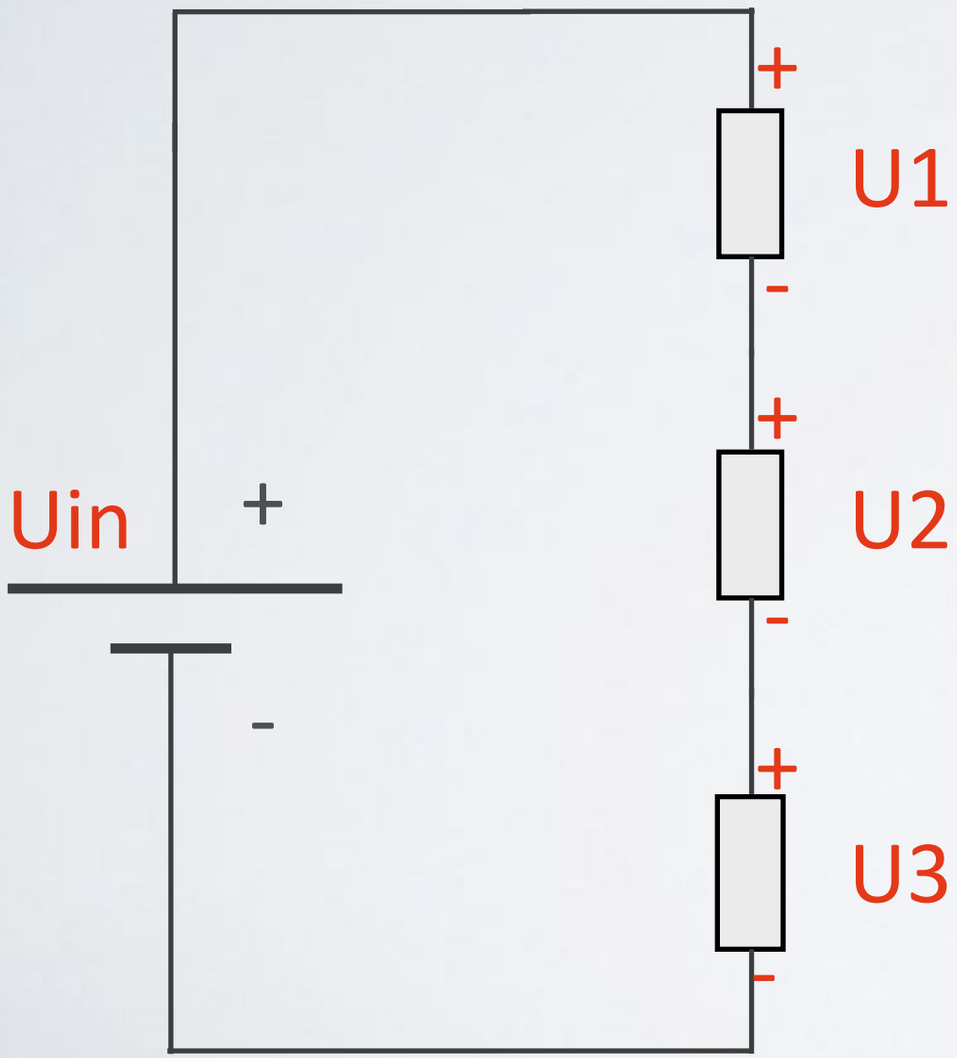
$R = \frac{U}{I}$ (Ohm )




A source of 1 Volt [V] and a resistor of 1 Ohm, will result in a current of 1 Ampere [A]

# 2nd Kirchoff's law:

The sum of all voltages inside a closed circuit are equal to 0.



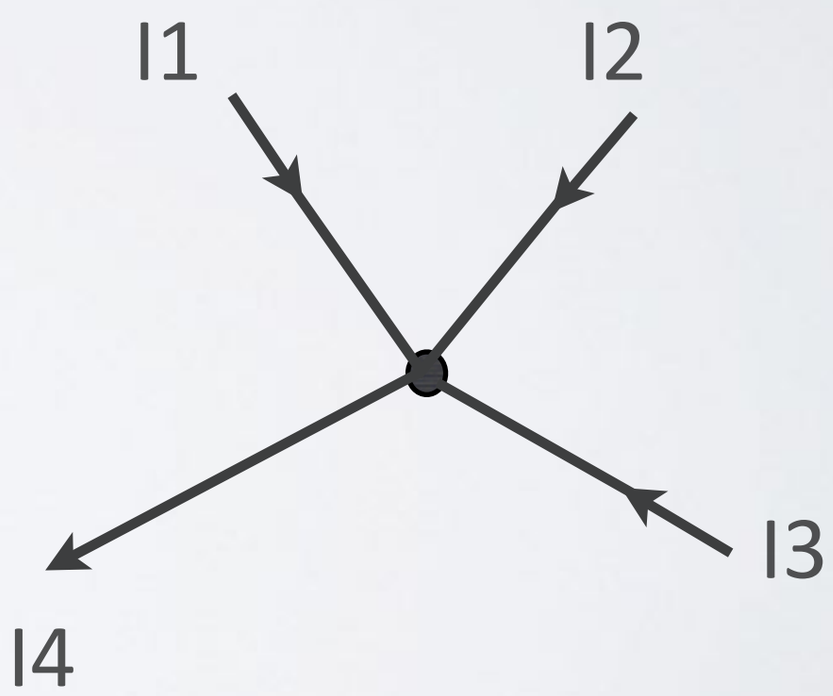

Uin = U1 + U2 + U3

**1 st Kirchoff's law:**

At any node (junction) in an electrical circuit, the sum of the currents flowing into that node is equal to the sum of currents flowing out of that node.

In other words: the sum of the current in that node = 0

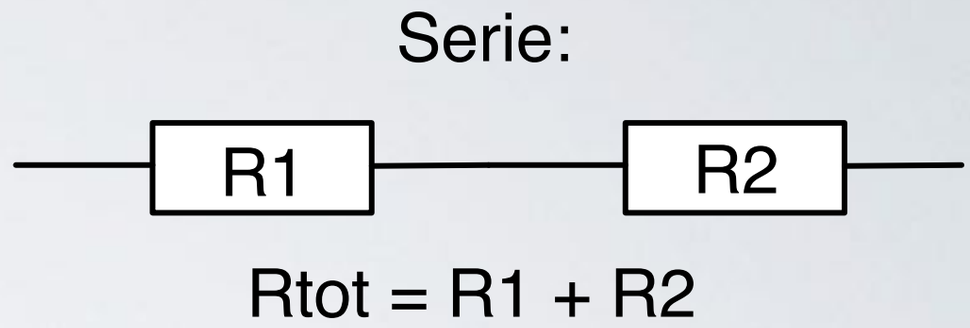
$$I1 + I2 + I3 = I4$$



# Introduction to Electronics

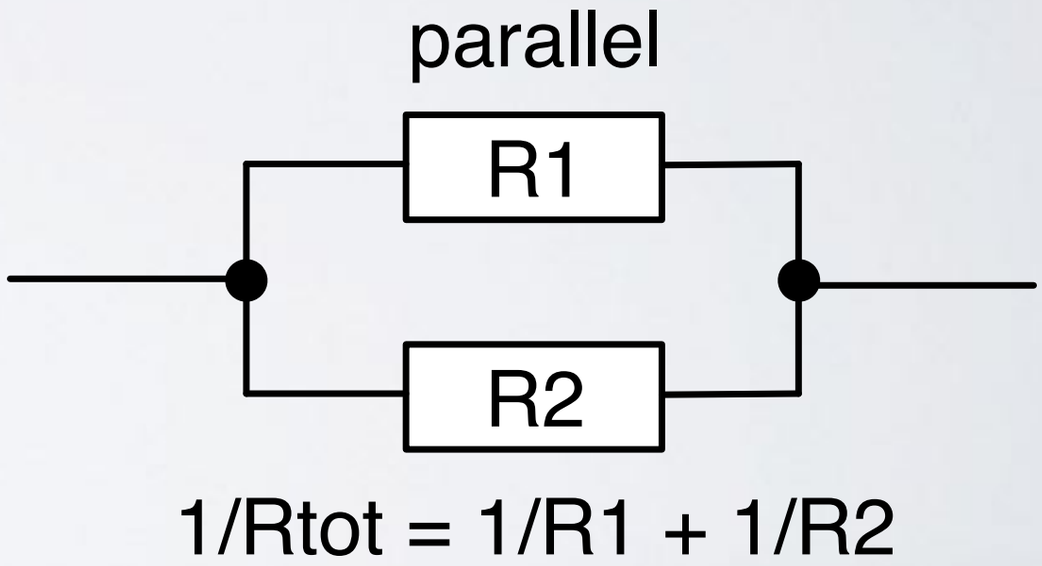
When resistors are placed in series, the **total resistance** will **increase** (bigger).

*The **voltage** will be divided.*

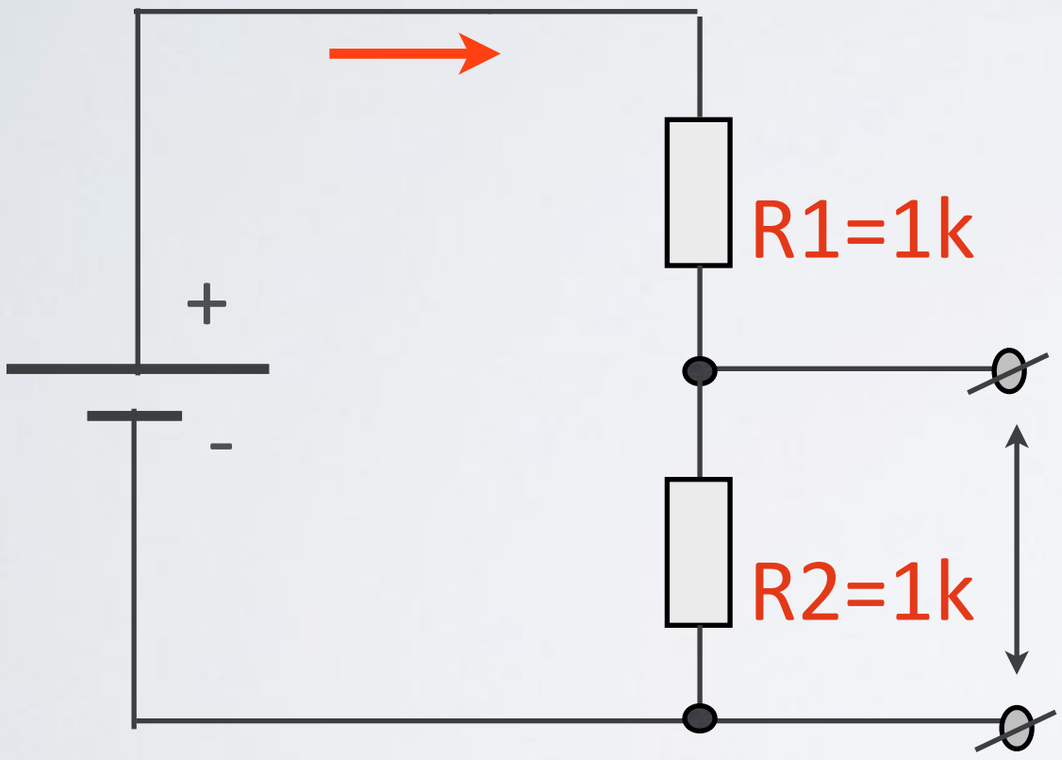



When resistors are placed in parallel, the **total resistance** will **decrease** (smaller).

*The **current** will be divided.*



# Multimeters ...



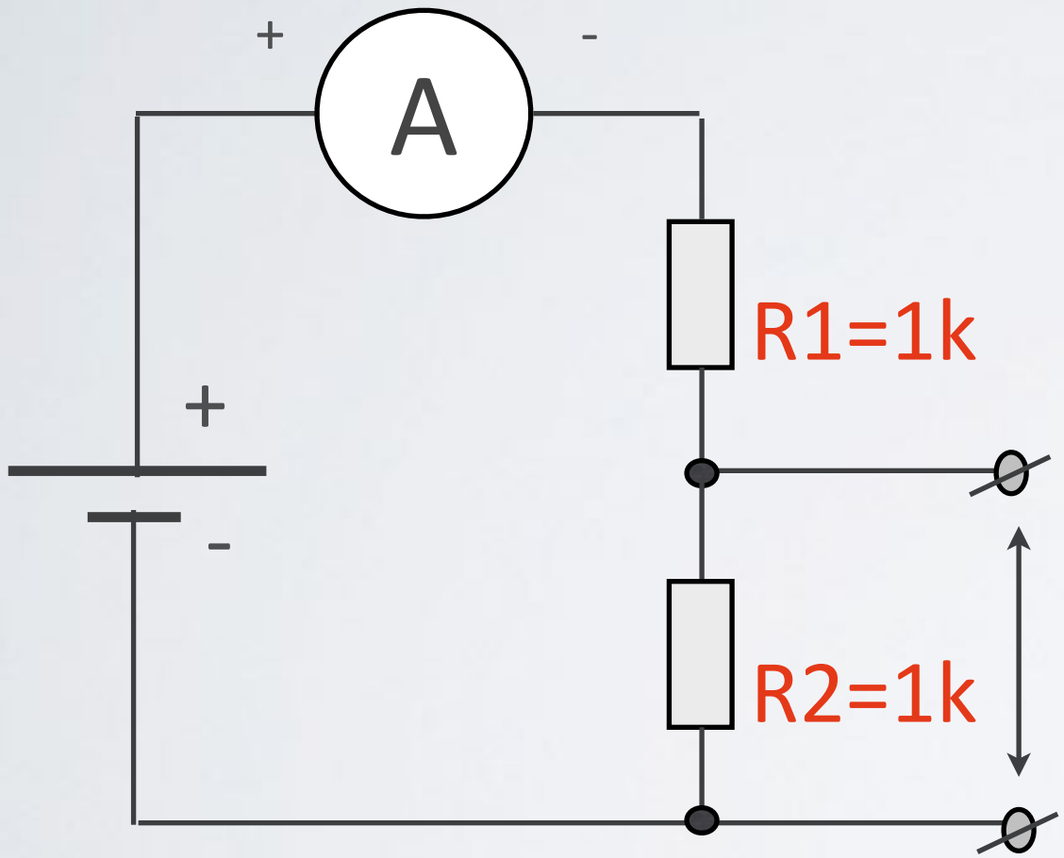

A

Current measurement
**R in = 0 Ohm**
Always connect in Series

V

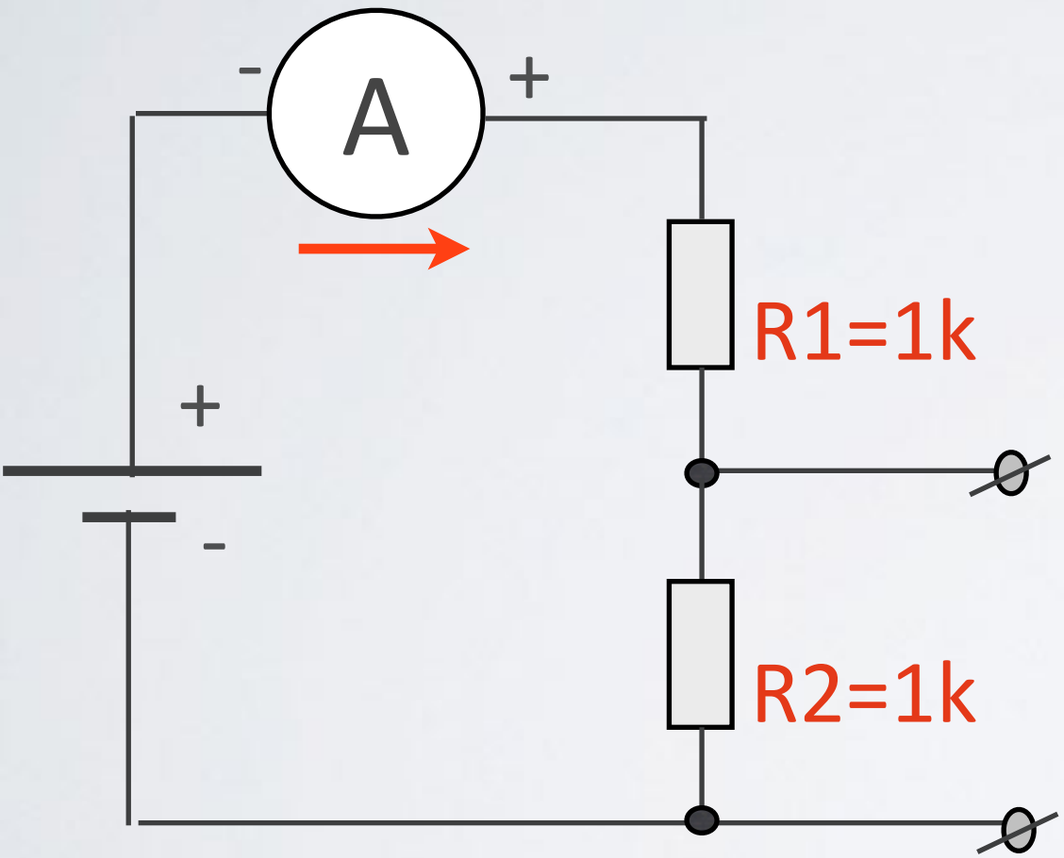
Voltage measurement
**R in = very high**
Always connect parallel

To measure the current with a multimeter, you have to connect the meter in SERIES with the wire. This means you have to disconnect the wire and place the multimeter in BETWEEN...




Current measurement
**R in = 0 Ohm**
Always connect in Series

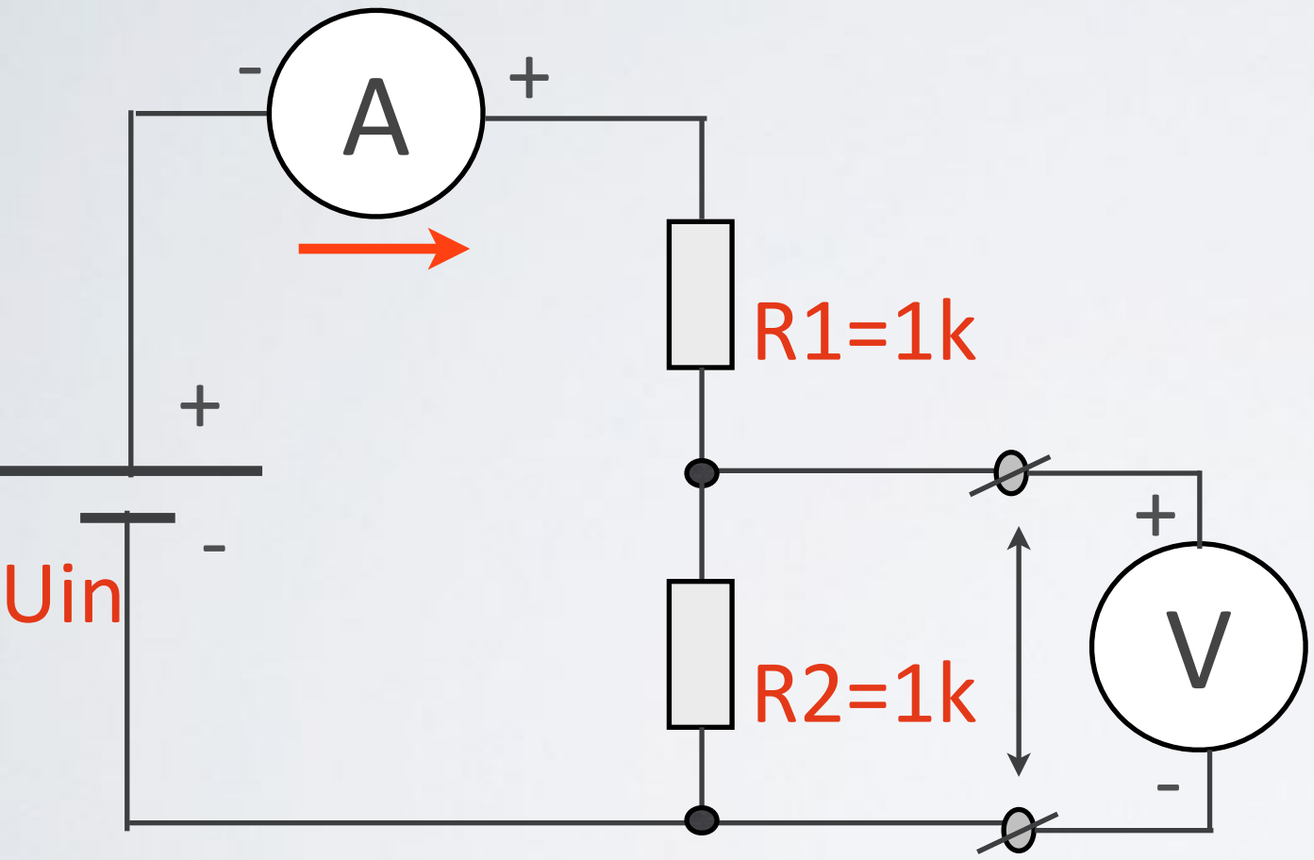
To measure the voltage, the multimeter has to be connected parallel





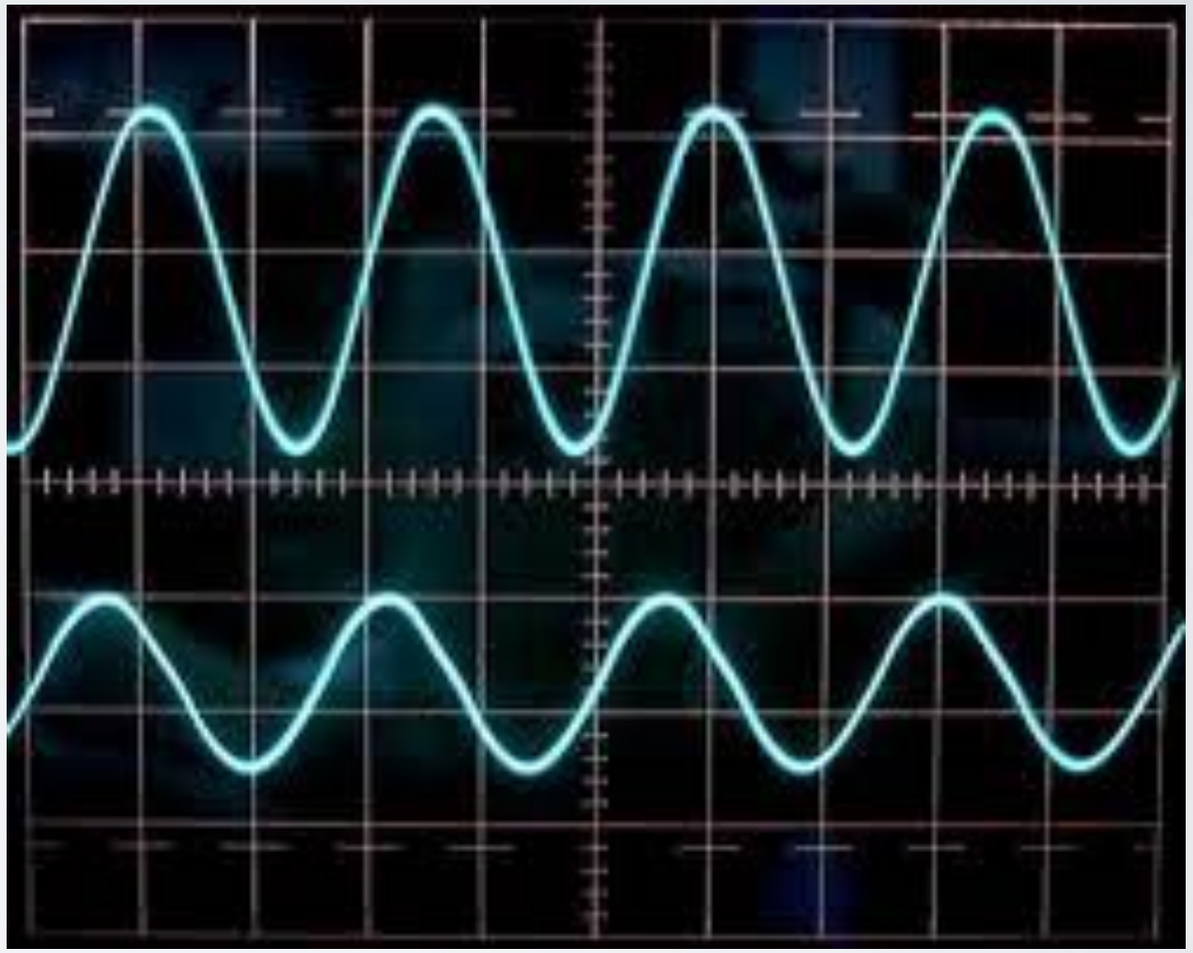
Voltage measurement
**R in = very high**
Always connect parallel

To measure the voltage, the multimeter has to be connected parallel




Voltage measurement
**R in = very high**
Always connect parallel

# To measure ac an dc signals, we make us of an oscilloscope

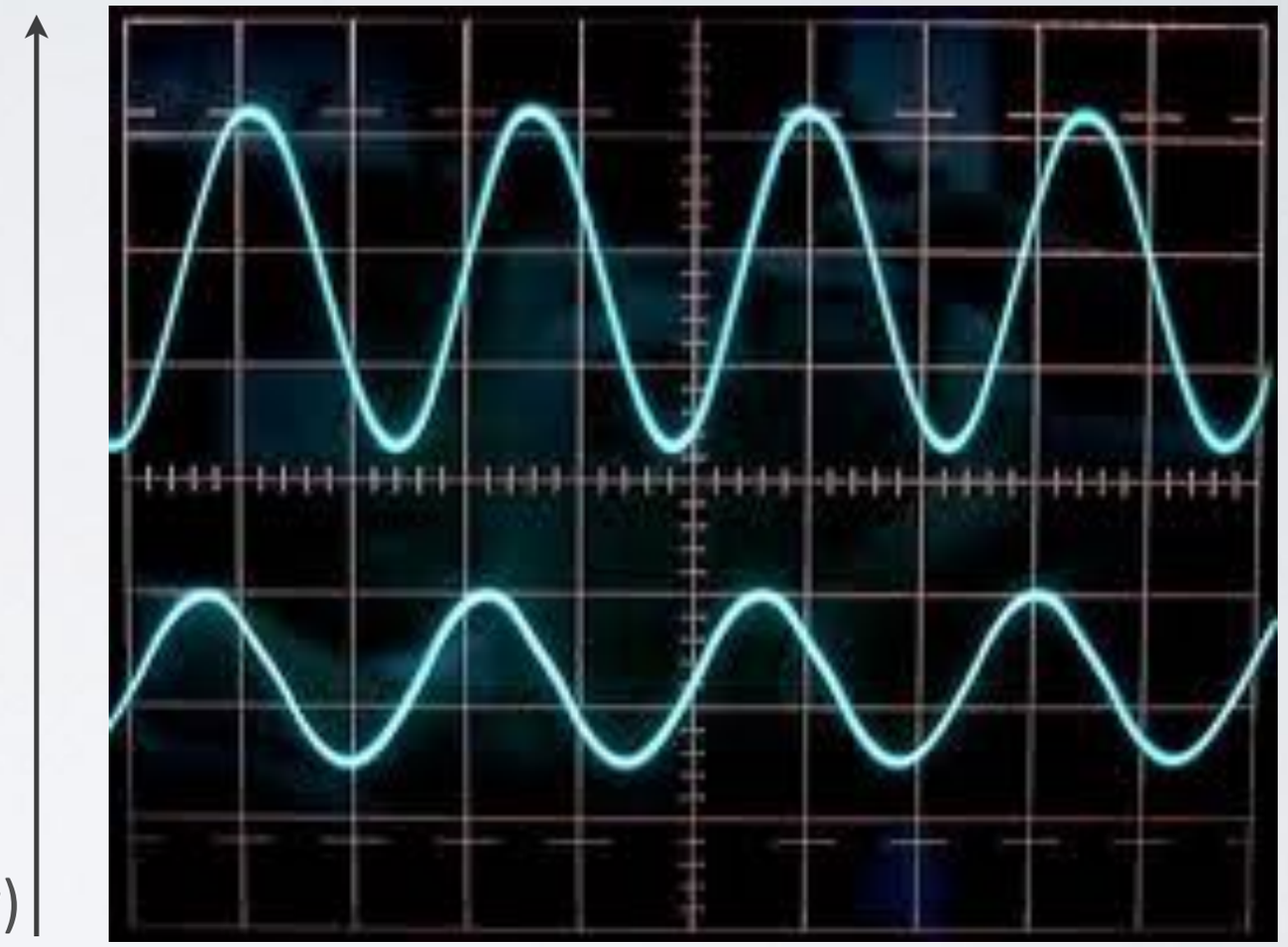


# To measure ac (dc) signals, we make us of an oscilloscope

The screen is divided into divisions

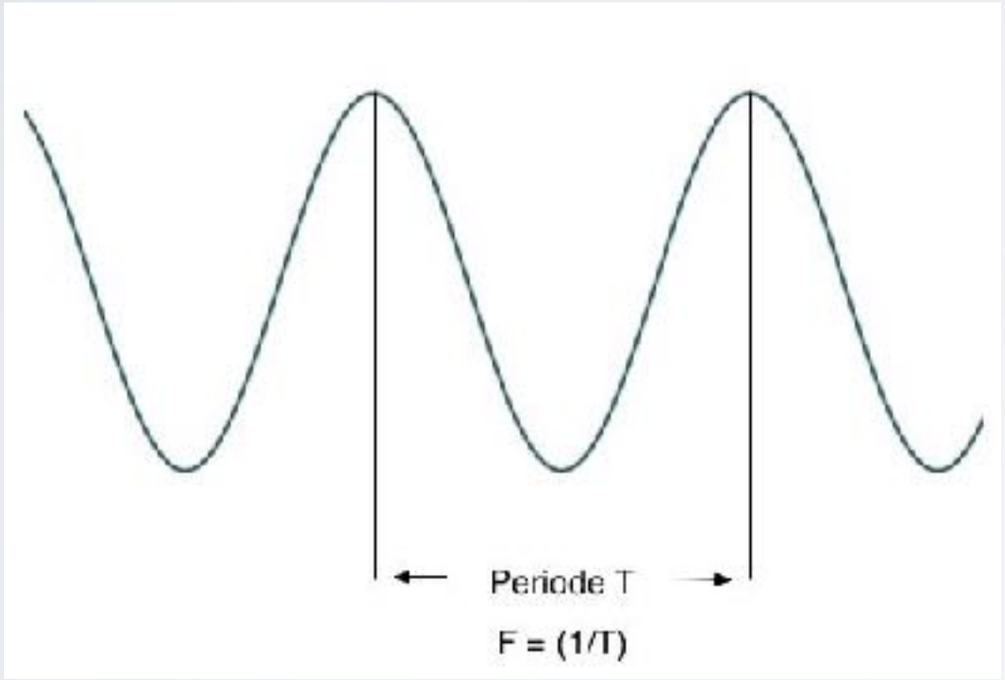
The vertical axis is the amplitude

The horizontal axis is the time



# To measure ac & dc signals, we make use of an oscilloscope

reminder:




F = Frequency [Hz]

T = Cycle [Sec]

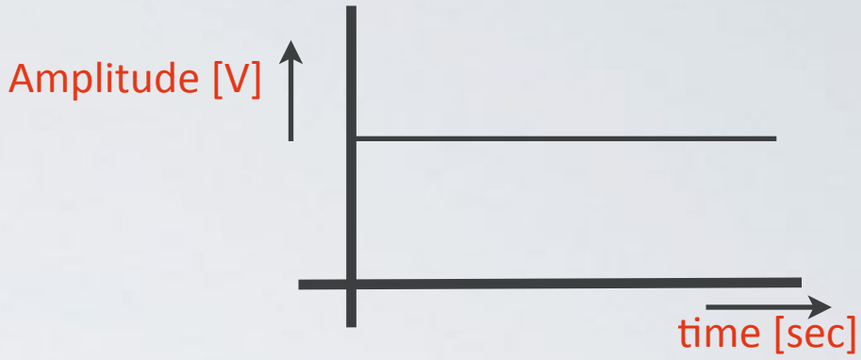
F= (1/T) en T = (1/F)

# Power Supply


# Power Supply

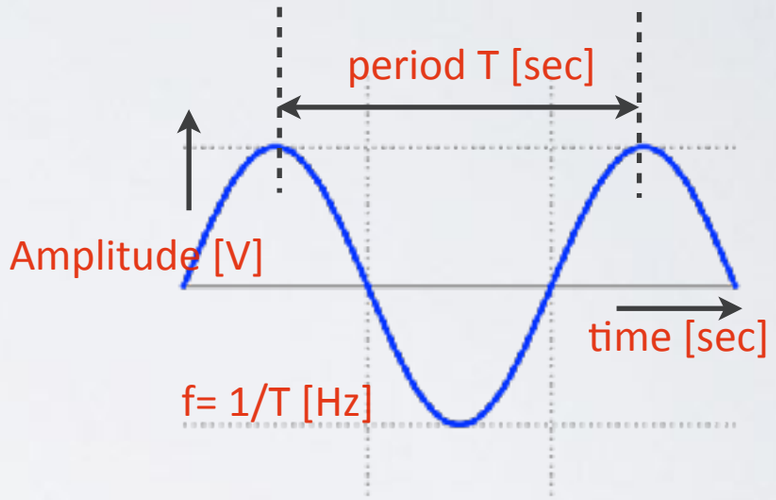
## DC … Direct Current.

Over time the value does not changes it’s value
It’s constant.



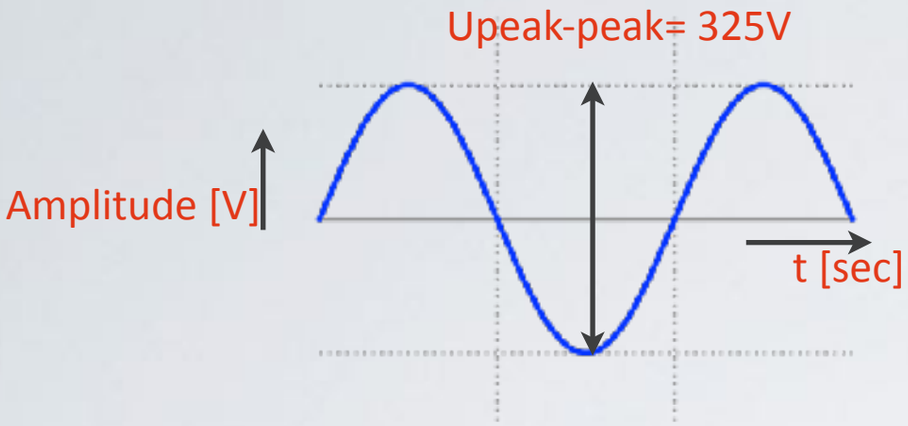

## AC … Alternating Current.

Over time the signal changes polarity



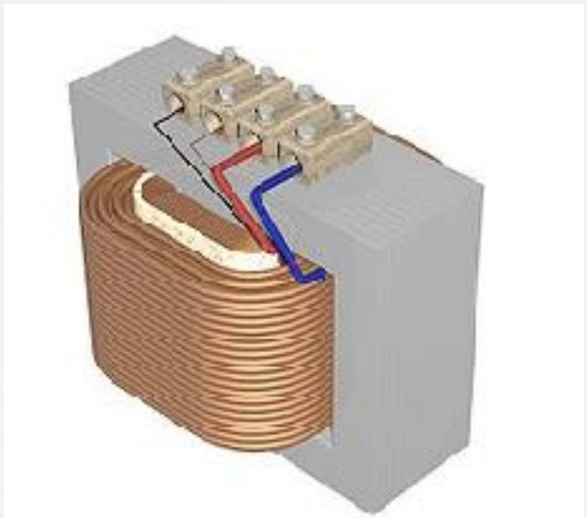

The mains connection in Europe IS 230V ~/ 50HZ

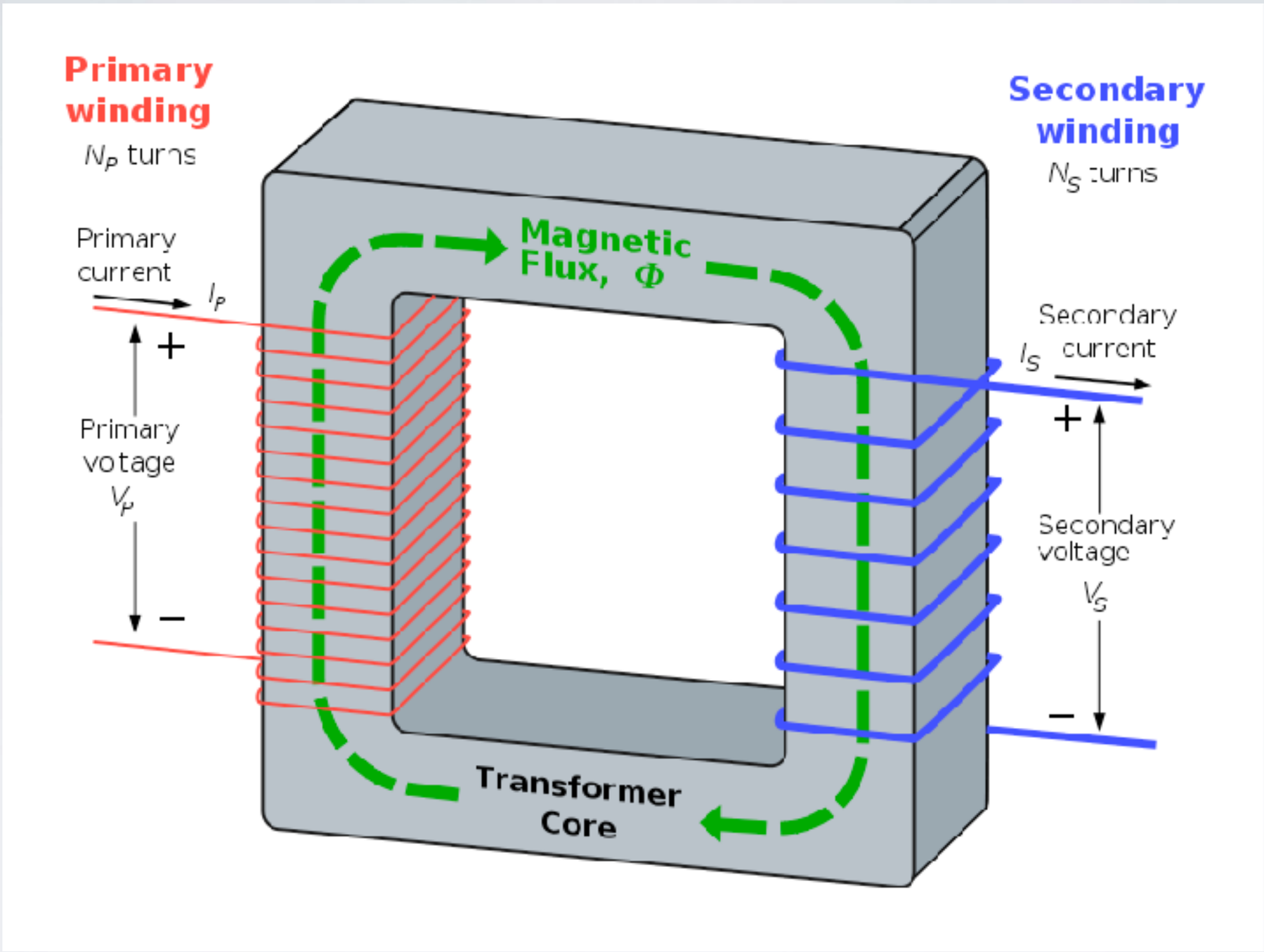
The mains connection in the USA is 110V~/ 60Hz




The mains connection on the wall provides us with 230V~ AC /50Hz.

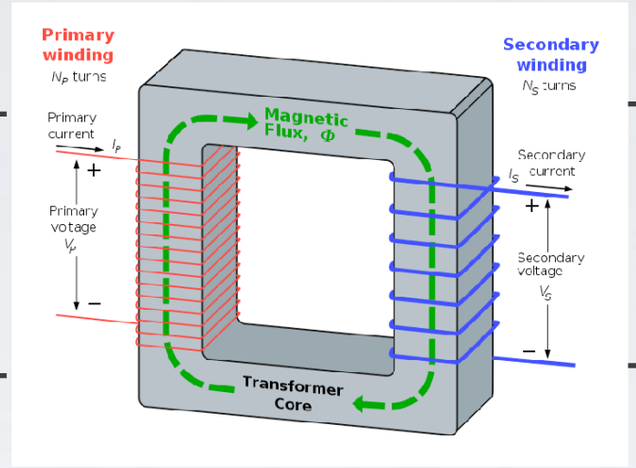
If we want to create low voltage DC (e.a.12V), we have to TRANSFORM the voltage down with a **TRANSFORMER**:




Primary winding
$N_P$ turns
Secondary winding
$N_S$ turns
Primary current
$I_P$
+
Primary votage
$V_P$
–
Magnetic Flux, Φ
Secondary current
$I_S$
+
Secondary voltage
$V_S$
–
Transformer Core

primary side

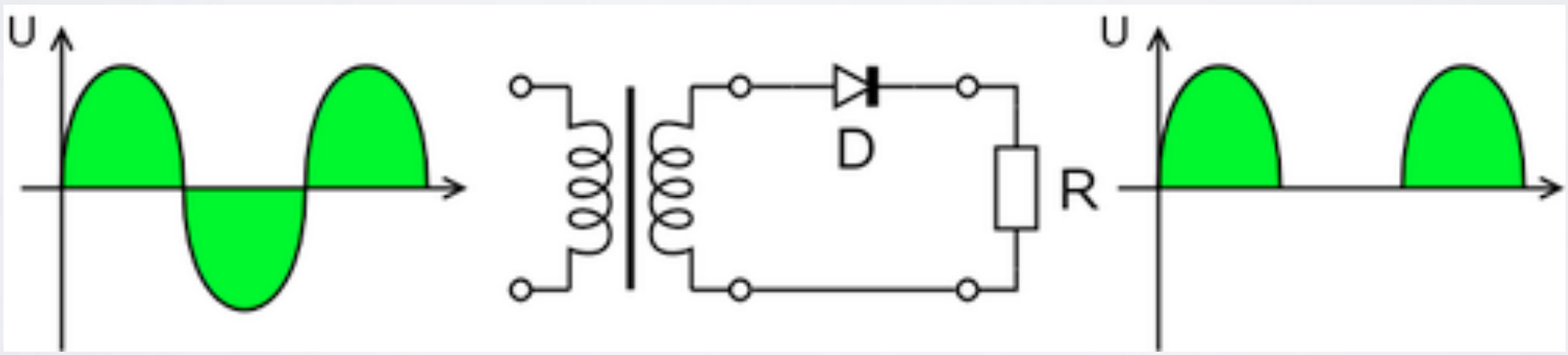
secondary side



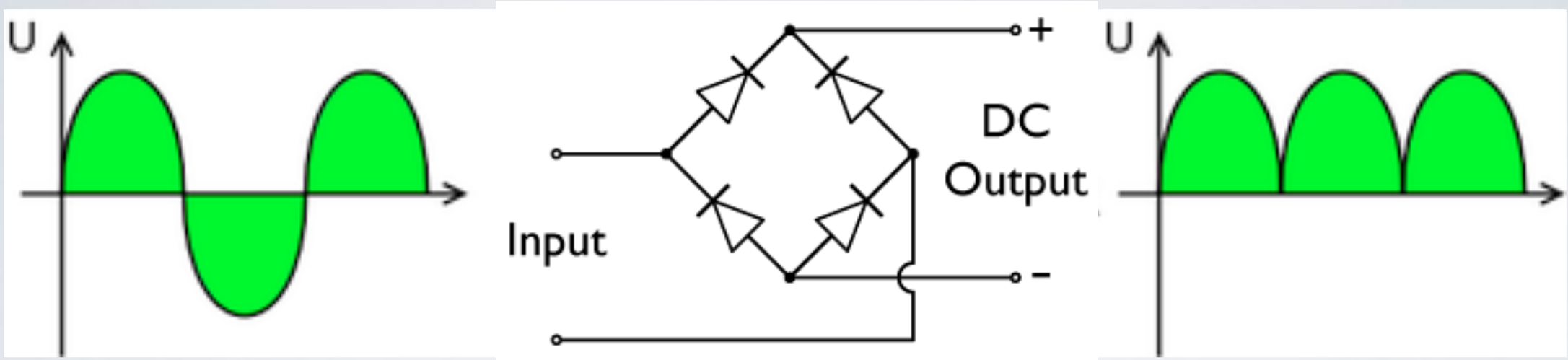

220V~/50Hz

12V~/50Hz

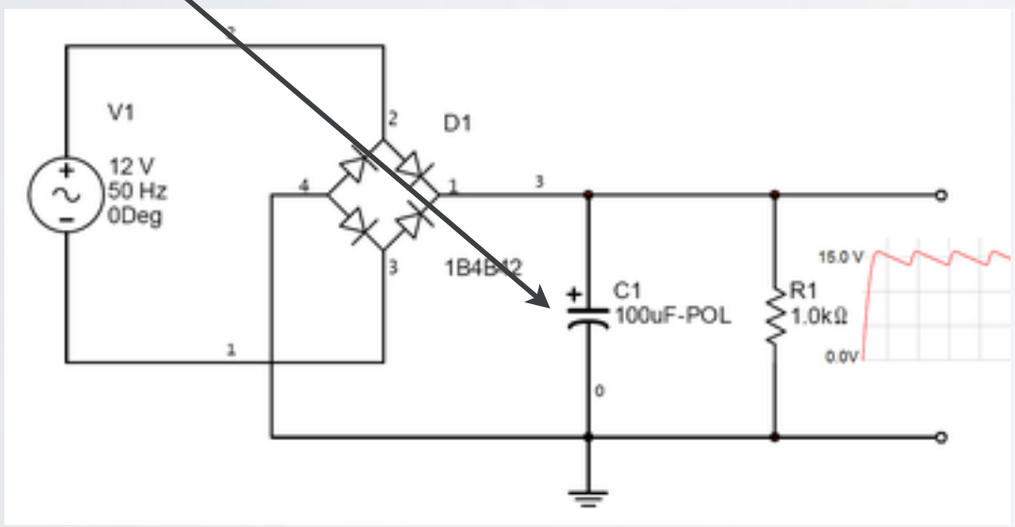
The lower value still is an AC signal. We need to RECTIFY this signal, in order to create a DC signal. We realize this with a rectifier circuit.

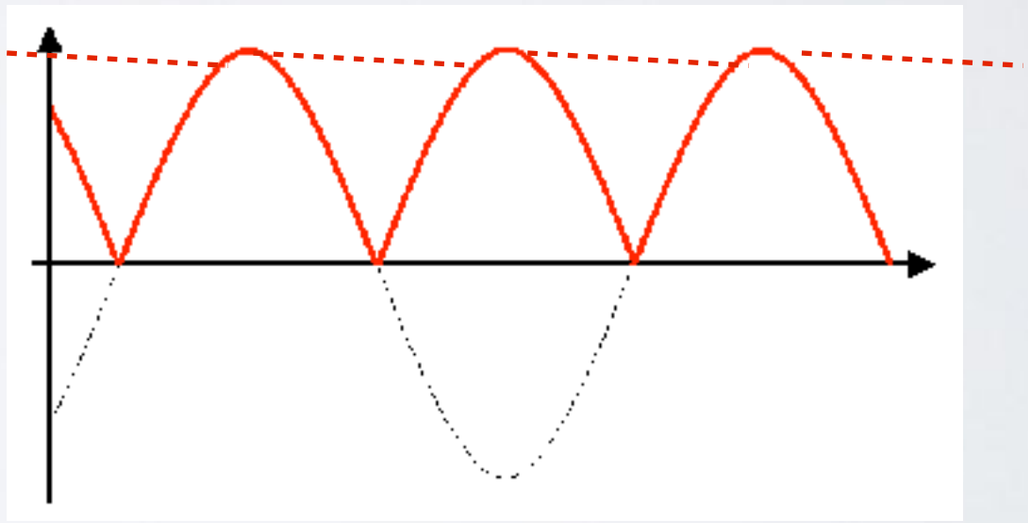


# Full wave rectification




A **capacitor** is used to smooth the signal



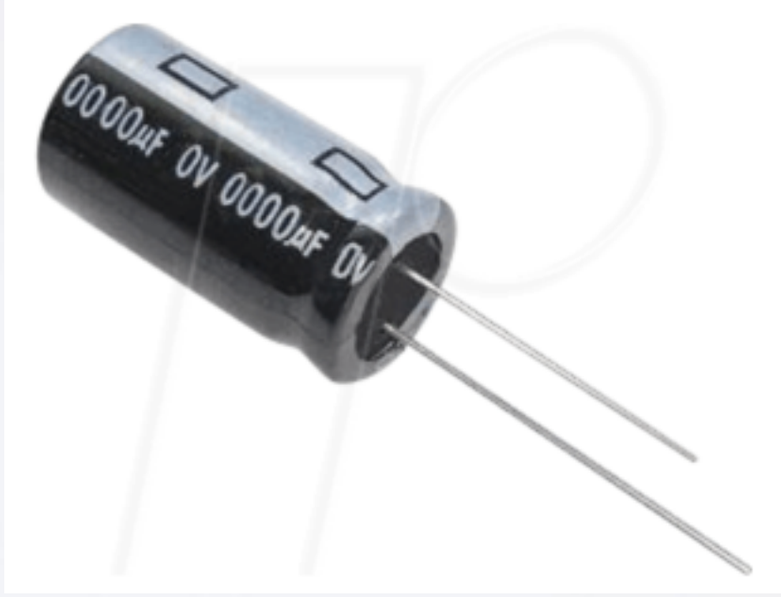



# What is a capacitor?

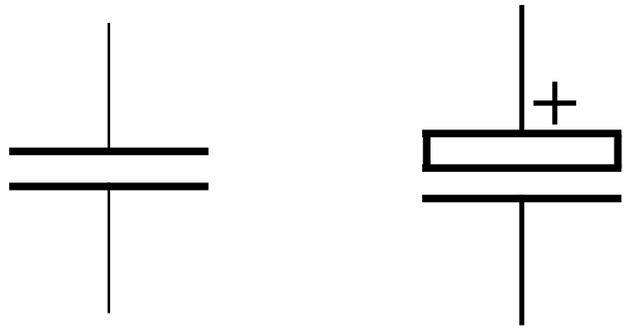
A **capacitor** or **condenser** is a passive electronic component consisting of a pair of conductors separated by a dielectric.

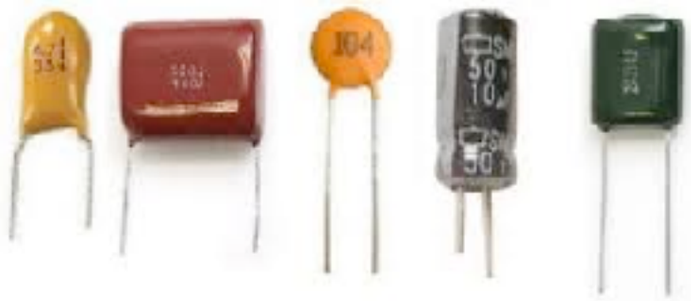
Capacitors are widely used in electronic circuits to block the flow of direct current (DC) while allowing alternating current (AC) to pass or to filter out interference, **to smooth the output of power supplies** and for many other purposes.

symbol



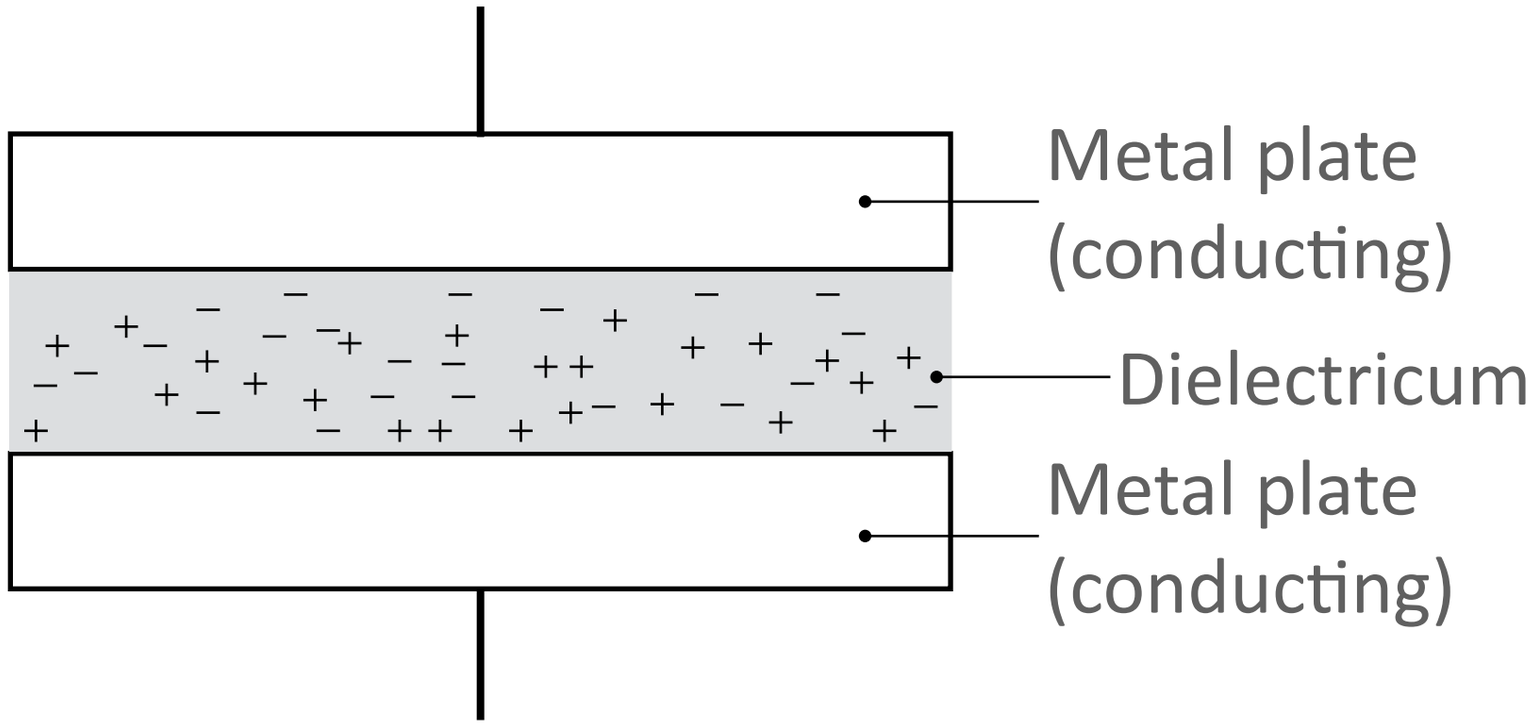
# Capacitors



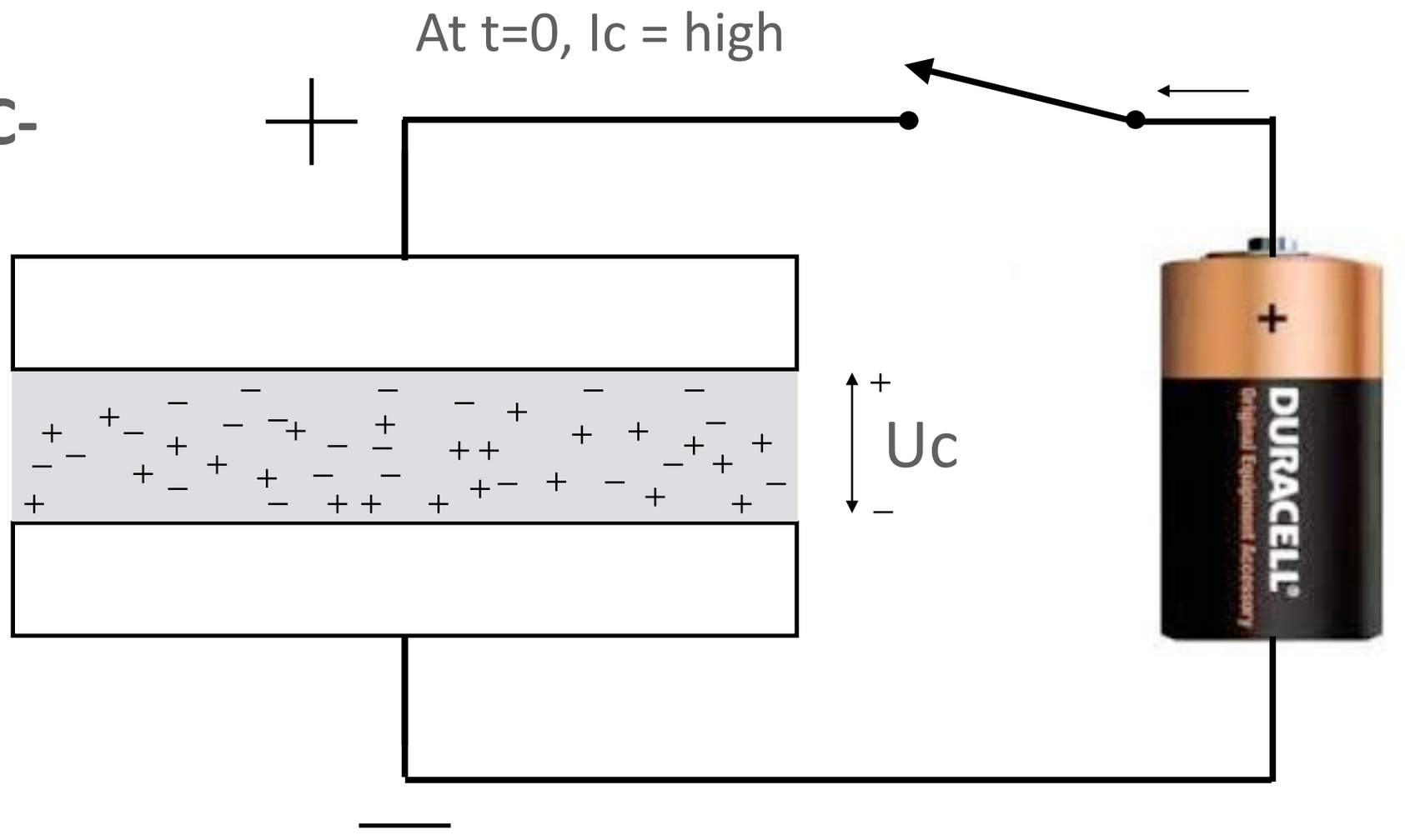




Not connected



Connected to a **DC-source**



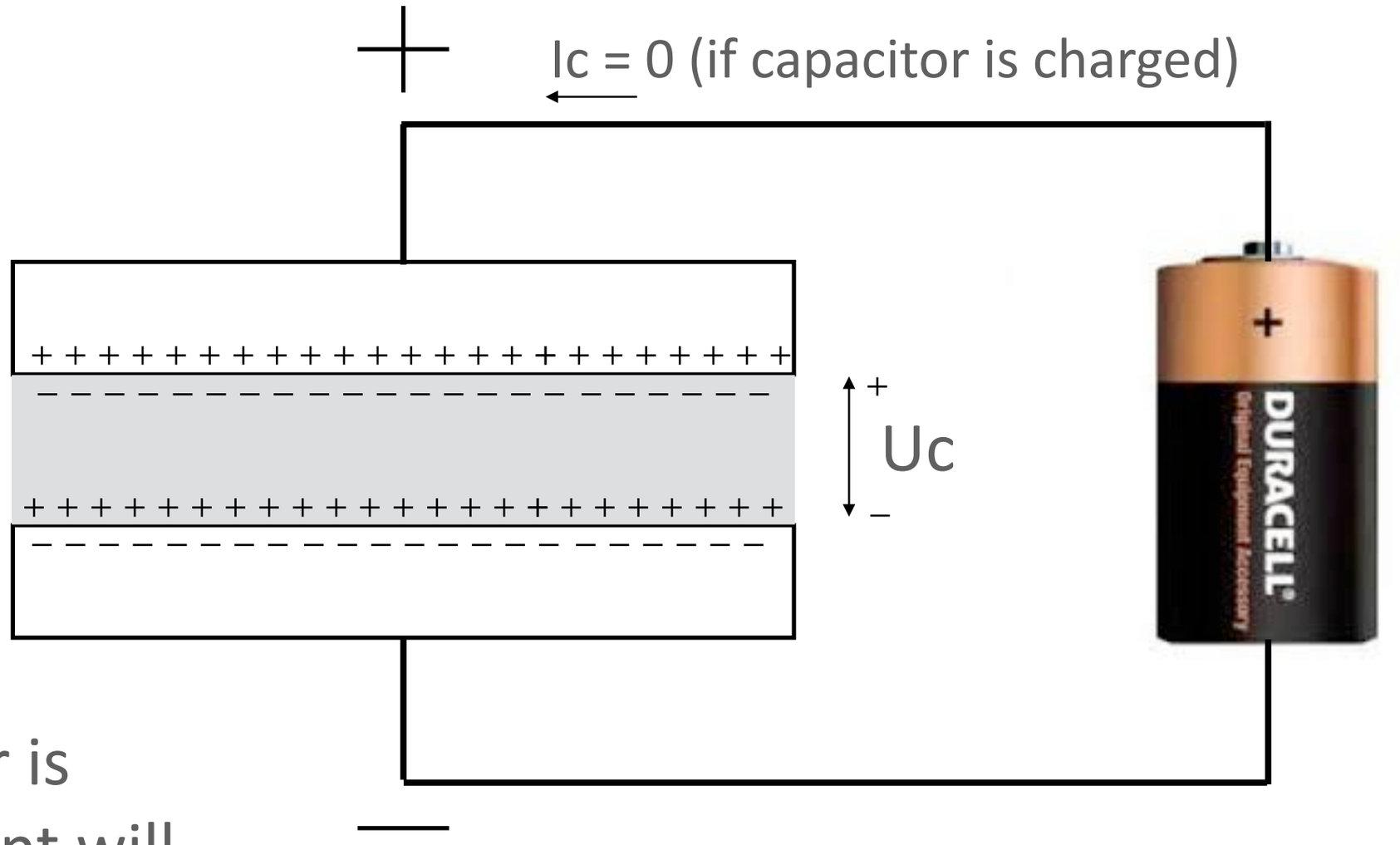

The capacitor will charge until Uc = U battery

The charge current is very high (at time=0 sec)

**For AC voltage, the Capacitor is a conductor or a resistor**

Connected
to a battery

The capacitor
will charge until
Uc = U battery

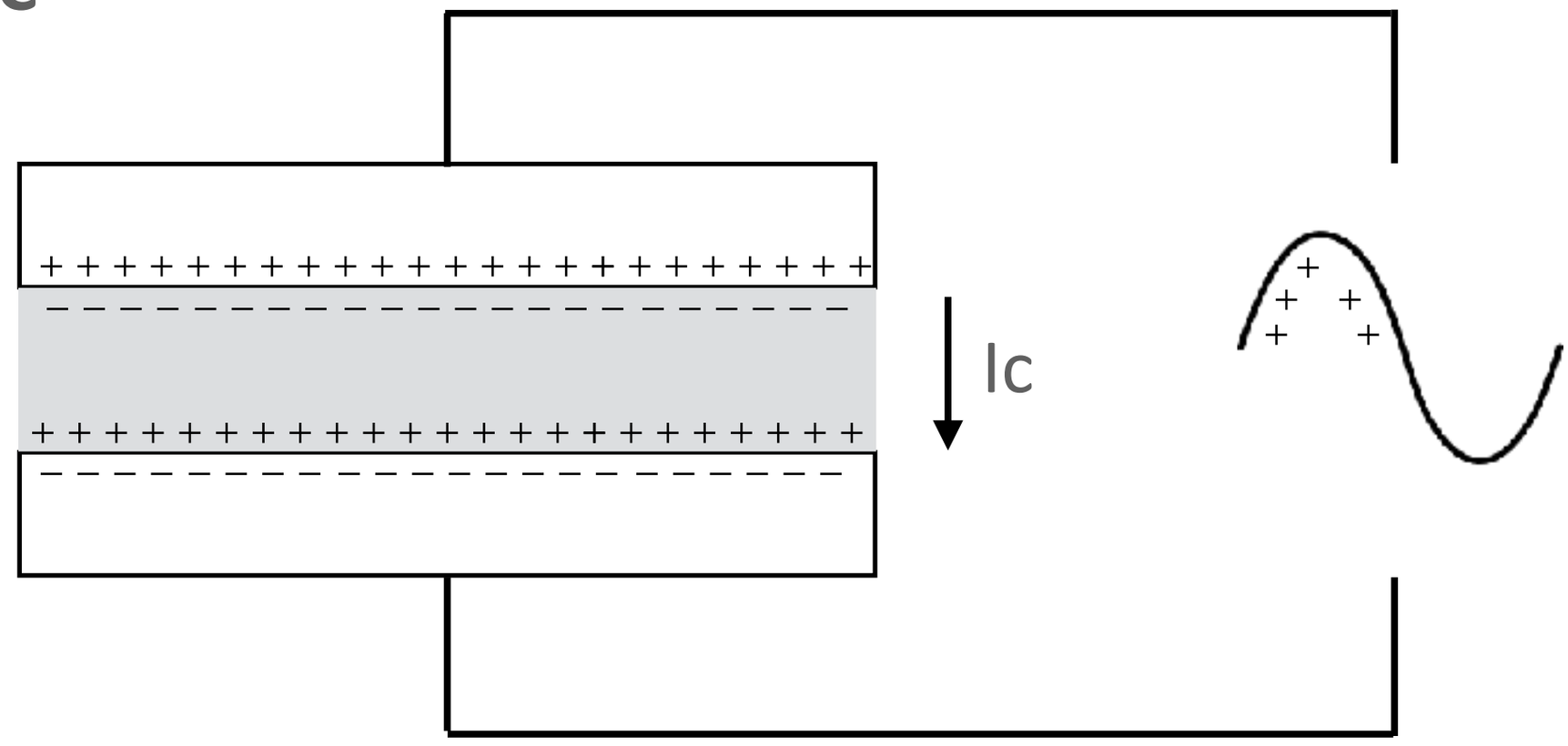



After the capacitor is
charged, the current will
be zero.

**For DC voltage, the Capacitor is a blockade (very high resistor) - the current is zero**

Connected to an **AC source**

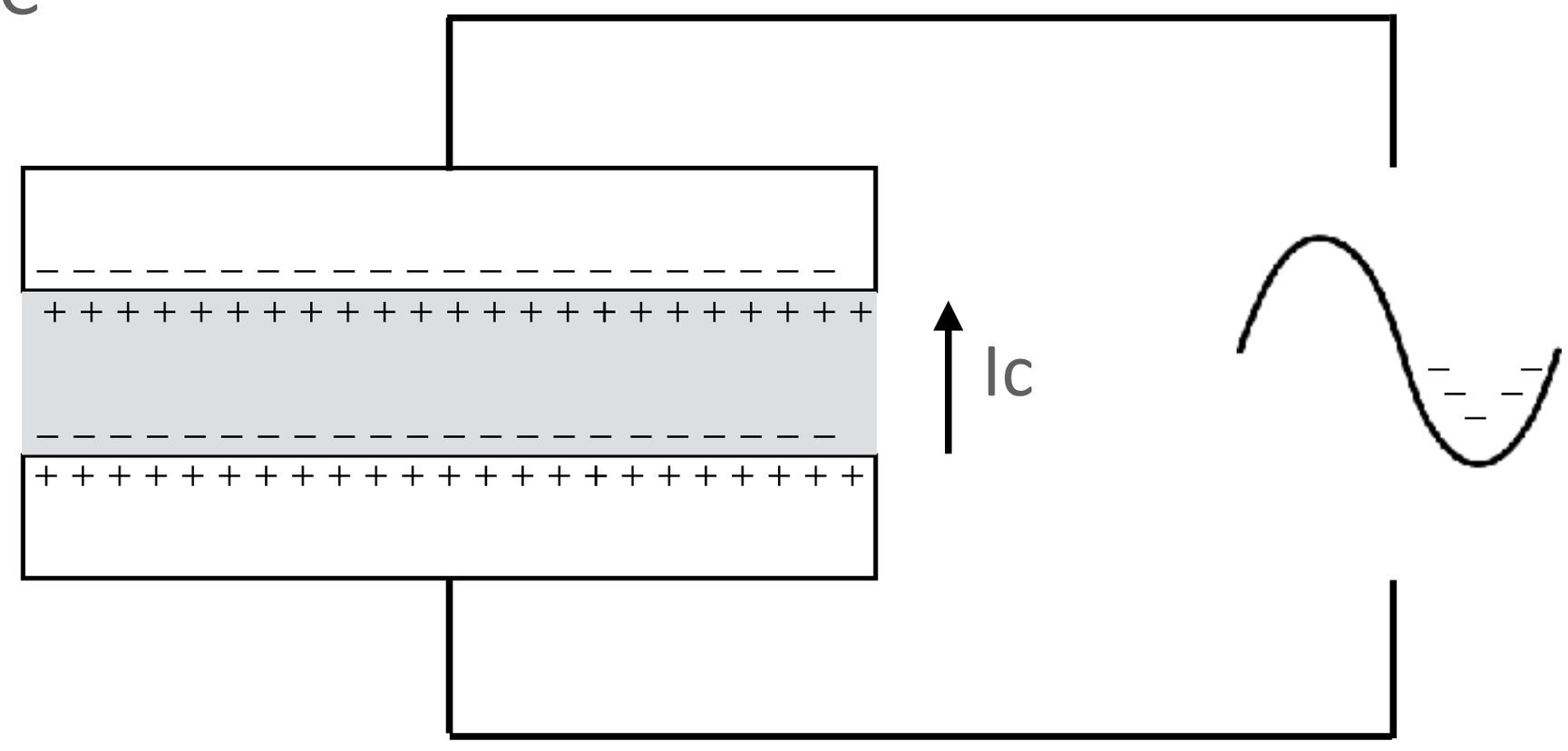
The capacitor will charge and discharge




**For AC voltage, the Capacitor is a conductor or a resistor**

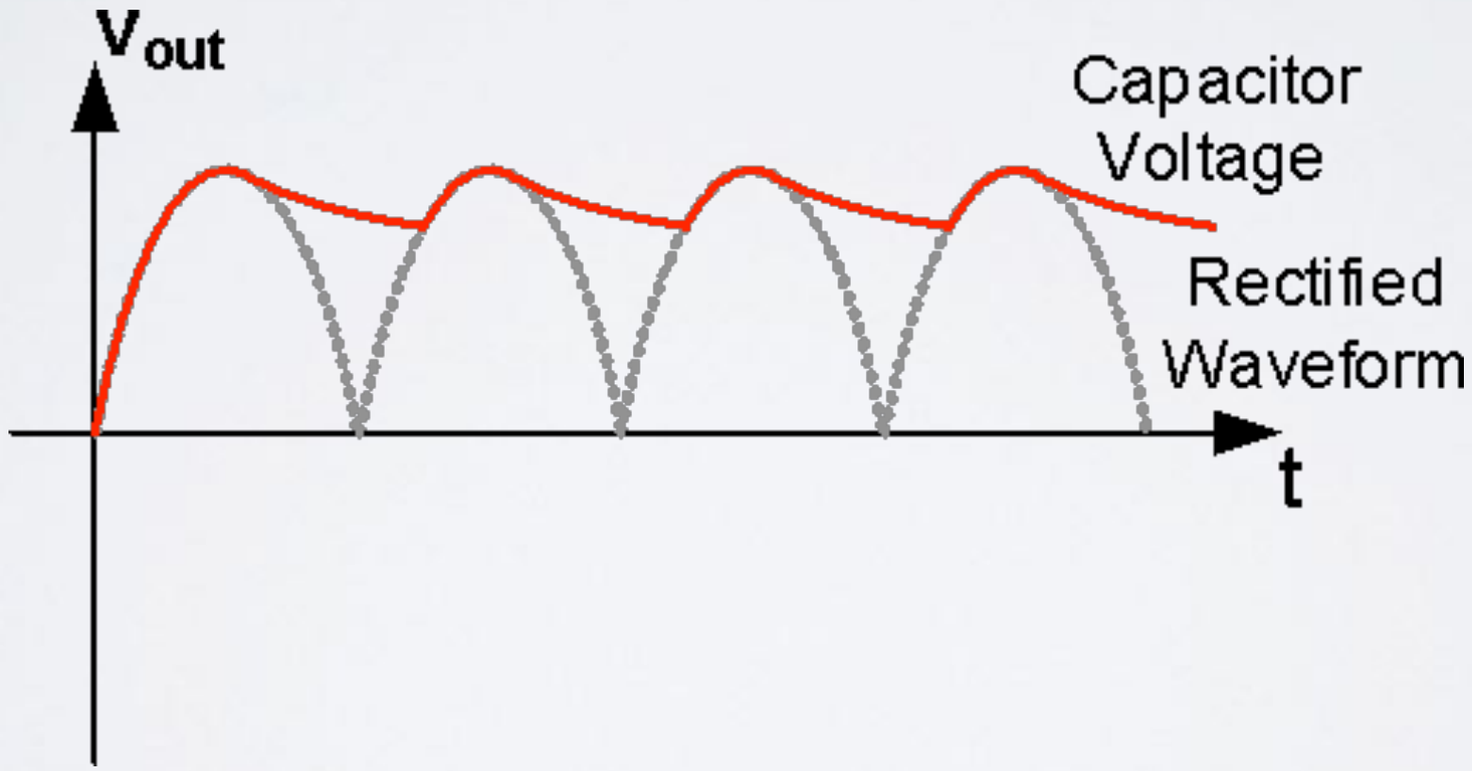
Connected to an AC source

The capacitor will charge and discharge

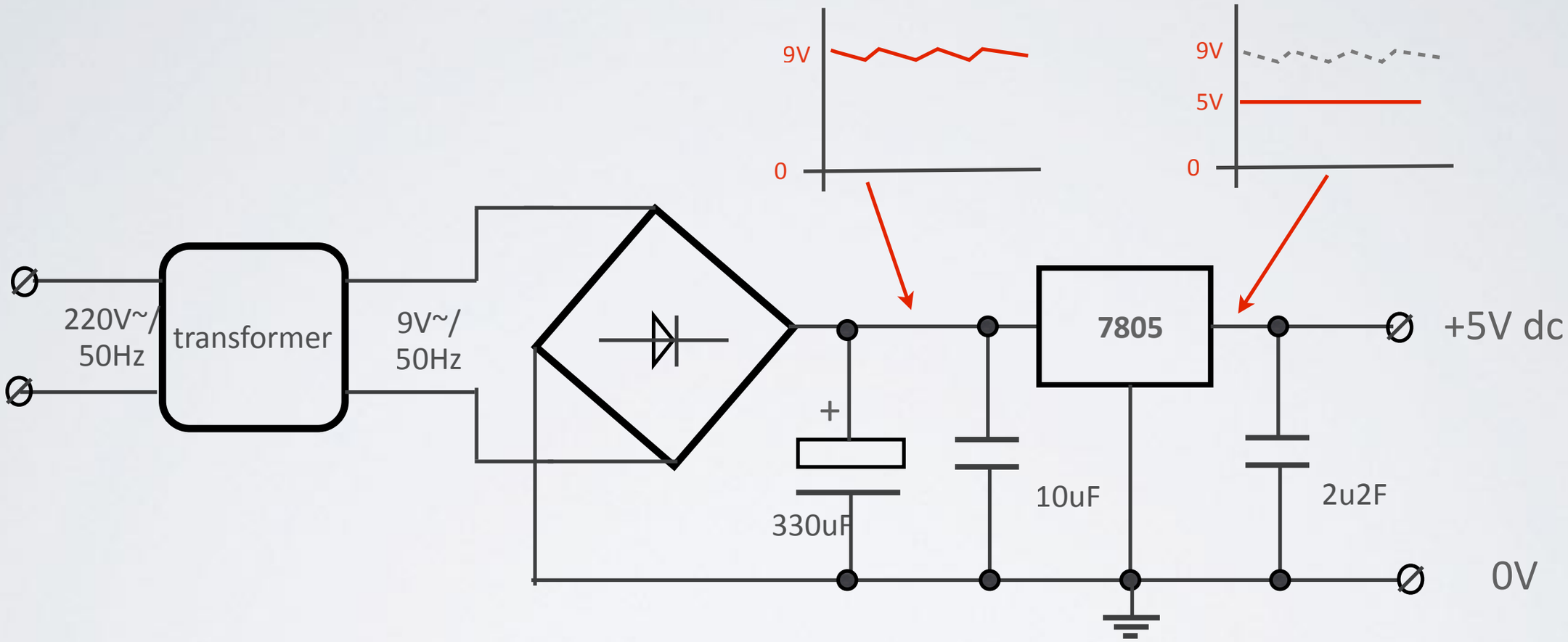



**For AC voltage, the Capacitor is a conductor or a resistor**

So, a **capacitor** is used to smooth the signal ...
The result is a dc-voltage with a “ripple”



To create a nice and steady DC voltage (without ripple), we make use of **voltage regulators**.




Voltage regulators exist in all kind of values ...7805, 7806, 7809, 7812, ...7824 ...

# Electronics software tools

**Circuit simulation examples:**

Yenka (www.yenka.com)
http://www.falstad.com/circuit/
http://dcaclab.com/
iCircuit (mac application)
Partsim (https://www.partsim.com/simulator#)

**Electronics tools:**

Fritzing (from breadboard to circuit/pcb)
Eagle (circuit drawing and pcb design)
Electronics toolbox (mobile app)