Georg Ohm

Part 3 Learning Objectives

- Understand the concepts of
- Voltage
- Resistance
- Current
- Analogue signals

Electromotive Force (EMF)

EMF is the force that drives electricity through circuits. Some example sources of EMF are:

- Batteries
- Solar panels
- Dynamos
- Mains power supply

EMF is measured in Volts (V.)

Potential difference (PD)

When a current flows through two parts of a circuit there will be a potential difference developed between them. Like EMF, potential difference is measured in Volts.

Often word Voltage is taken to mean both potential difference and EMF.

Current

Current is the flow of electrons through a circuit. The current is related to the number of electrons that pass through a point in the circuit in one second. Current is therefore a measure of the amount of electricity flowing through a circuit. Current is measured in Amperes (A.)
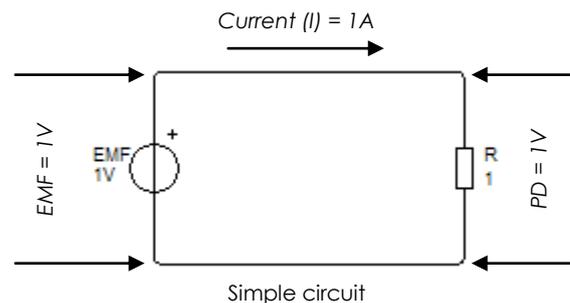
Resistance

All materials offer somes resistance to the flow of electric current. If a material has a high resistance then is limits the flow of current to a greater degree than a material with a low resistance. Resistance is measured in Ohms (R or Ω.)

Ohm's Law

Voltage, current and resistance are all related to one another. The way they are related is described by Ohm's Law, the basic explanation being:

The current flowing through a circuit is proportional to the voltage and inversely proportional to the resistance of the circuit.

Simple circuit

Voltage (V) = Current (I) x Resistance (R)

Current (I) = Voltage (V) ÷ Resistance (R)

Resistance (R) = Voltage ÷ (V) Current (I)

In the circuit shown above has an EMF of 1V in parallel with a 1Ω resistor. In this case the PD across the resistor is equal to the EMF.
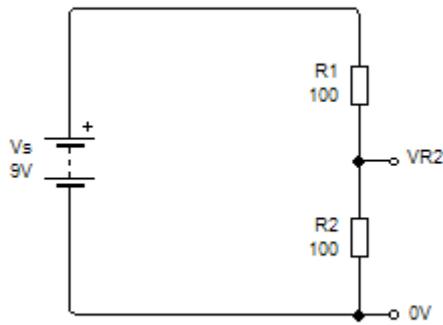
The current is calculated:

$$I = V \times R$$

$$I = 1 \times 1 = 1A$$

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Potential Dividers

A potential divider is a circuit that is used extensively in electronic systems. It allows a potential difference to be developed from a current source and input transducers.

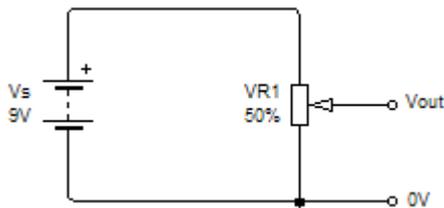The simple circuit below is used to produce a potential difference of 4.5V across the R2:

A potential divider

$$V_{R2} = \frac{V_S \times R2}{R1 + R2}$$

$$V_{R2} = \frac{9 \times 100}{100 + 100} = 4.5V$$

Potentiometers

Potentiometers can be used to produce adjustable potential differences. The output of this circuit (Vout) can be adjusted between 0V and 9V:

Circuit for producing an adjustable voltage of 0V to 9V

Potential dividers and inputs:

Input transducers are often incorporated into potential dividers in order to produce an output voltage relative to the input conditions.

An example of this is with the use of an LDR. The circuits below show how a potential divider can be used to produce a voltage output relative to the light level:
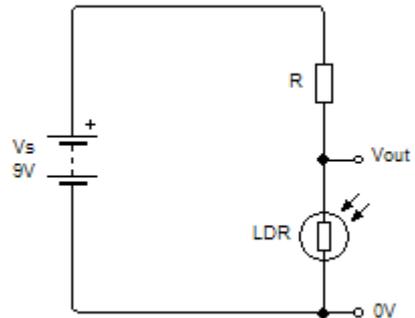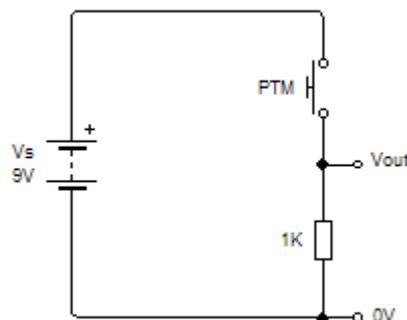
Switches

The circuits below are often used in digital systems to produce a voltage depending on the position of a switch to represent the two logic levels:
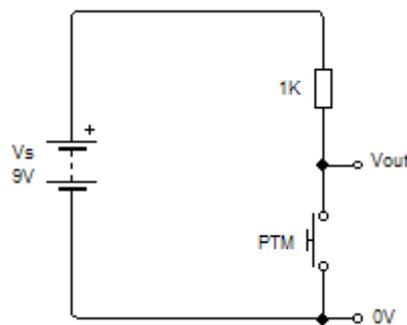
Normally Vout is pulled up to 9V by the 1K resistor.

When the switch is pressed Vout will be pulled down to 0V, this is because it has a much lower resistance than the resistor.

Output normally 9V, pulled down to 0V by switch

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