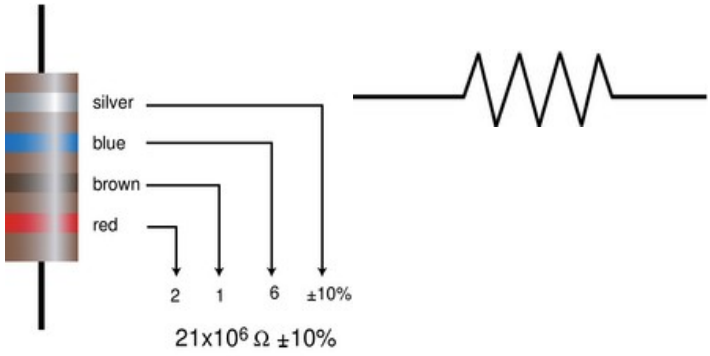
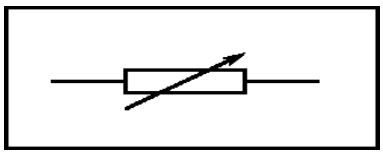
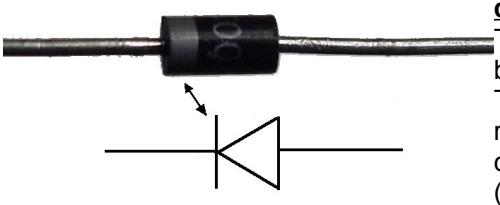
Summary lesson 2. Electronic

A **resistor** is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current.

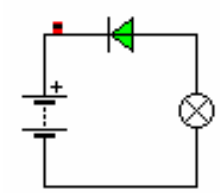


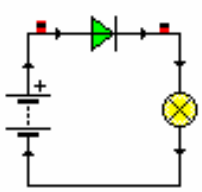
A **potentiometer** is a three-terminal resistor with a sliding contact to change the value.	
LDR (Light Dependent Resistor). Is a resistor whose resistance decreases with increasing incident light intensity.	
Termistor NTC. Is a resistor whose resistance decreases with increasing temperature.	
Termistor PTC. Is a resistor whose resistance increases with increasing temperature.	

Semiconductor devices

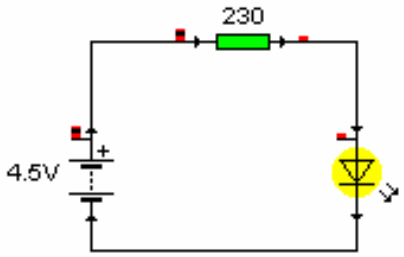


A **diode** is the simplest form of semiconductor. **Diodes are a discrete component that allows current to flow in one direction only**.
The direction that current is allowed to pass is called the forward bias.
The direction that current is not allowed to pass is called the reverse bias. A diode has two leads: for forward bias, the current comes in at the anode (positive lead) and out at the cathode (negative lead).



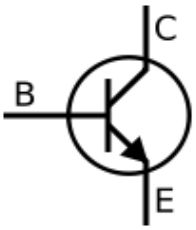


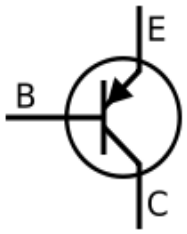
A **LED** is a semiconductor diode that emits light when an electric current is applied in the forward direction of the device. A LED should has a resistor (230 Ohms) in series.



Electronics began with the development of the transistor in the 1950s. Transistors are essentially tiny semiconductor amplifiers and/or switches, several thousands of which can be put on a 1mm2 piece of silicon.

Transistors have three leads: the **emitter**, **collector** and **base**. The base lead controls the transistor: applying an electrical current to the base lead switches the transistor on. When the transistor is on, current flows from the collector to the emitter - but when it is off no current will flow.



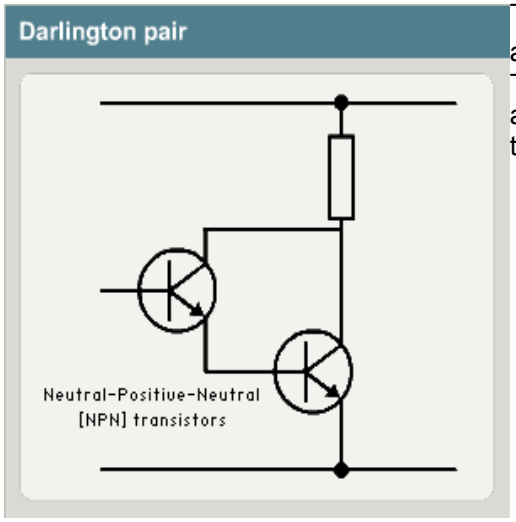


NPN **PNP**

Operation regions of transistors.

- **Active**. **Ic = GAIN . IB**
- **Saturation**: the base electrical current (IB) is high, then the collector electrical current (IC) is constant, Isat, called **saturation current**.
- **Cutoff**: the base electrical current is zero I_B**=0 A**, or very low, then there is no current in the collector, I_C**=0A**. The transistor doesn´t allow the flow of charges.

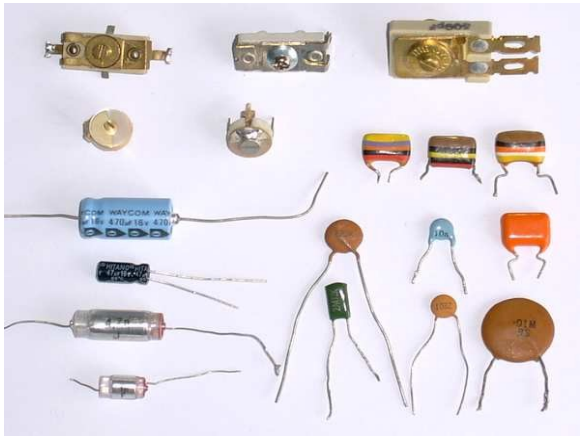
Some transistors can take a very low current flowing in the base and amplify it to give a much higher current in the collector (called gain). Other transistors can output a large current at the collector - but without very much gain. Single transistors cannot have both high gain and high collector current.



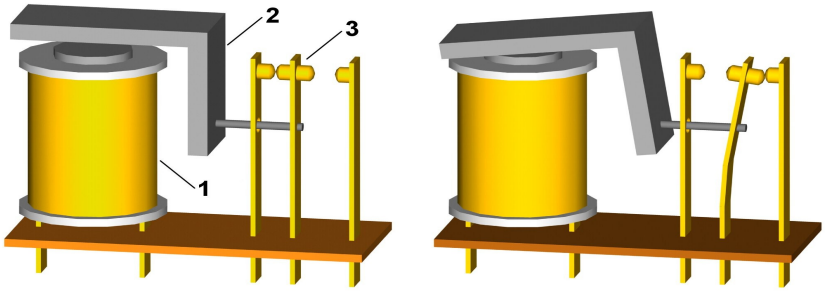
To overcome this problem, a high-gain transistor is paired up with a high-current transistor in what is called a **Darlington pair**. The combined transistors allows both a higher gain and a larger amount of current to flow than would be possible with a single transistor. Darlington pairs are often used to drive motors.

A **capacitor** is a discrete component which can store an electrical charge for a period of time. The larger the capacitance the more charge it can store.
The unit of measurement of a capacitor is the farad. Often you will see capacitors of much less than a farad. These will be measured in microfarads (one millionth of a farad or 1/1,000,000) or picofarads (one million-millionth of a farad or 1/1,000,000,000,000).
There are two types of capacitor:

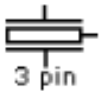
- polarised or electrolytic capacitors, and
- non-polarised or non-electrolytic capacitors.



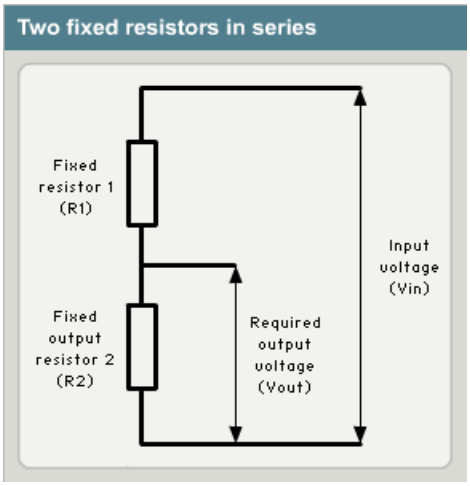
Relay: is an electrical switch that opens and closes under the control of another electrical circuit. The switch is operated by an electromagnet to open or close one or many sets of contacts.

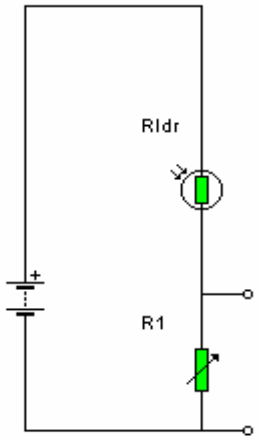


Electronic circuit diagram components (symbols)

Symbol	Component	Symbol	Component	Symbol	Component
	Joined conductors		Crossing conductors -no connection		Single-Pole-Single-Throw switch (SPST) (normally open)
	Fixed resistor		Diode		Single-Pole-Single-Throw switch (SPST) (normally closed)
	Potentiometer		Light-Emitting Diode (LED)		Single-Pole-Double-Throw switch (SPDT)
	Preset potentiometer		NPN transistor		Double-Pole-Double-Throw switch (DPDT)
	Thermistor		Amplifier		Push-To-Make switch (PTM)
	Light-dependent resistor		Fuse		Push-To-Break switch (PTB)
	Polarised capacitor		Resonator		Dry-reed switch
	Non polarised capacitor				Opto switch
	Power supply		Primary or secondary cell		Relay (with double-throw contacts - contact symbol varies with type used)
			Battery (of cells)		

Note: Relay Symbol - The symbol consists of a relay coil and contacts. Contacts are usually drawn separate from the coil at convenient points on the circuit diagram and are always shown in the unoperated position.





$$Vs = Vin \cdot \left(\frac{R1}{(R1 + R_{ldr})} \right)$$