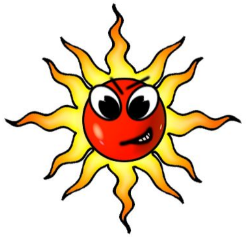
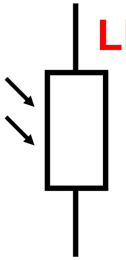
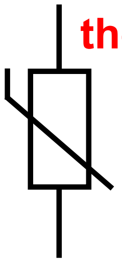
1. Components





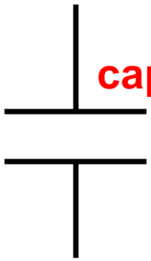
LDR

As light level increases, resistance decreases



thermistor

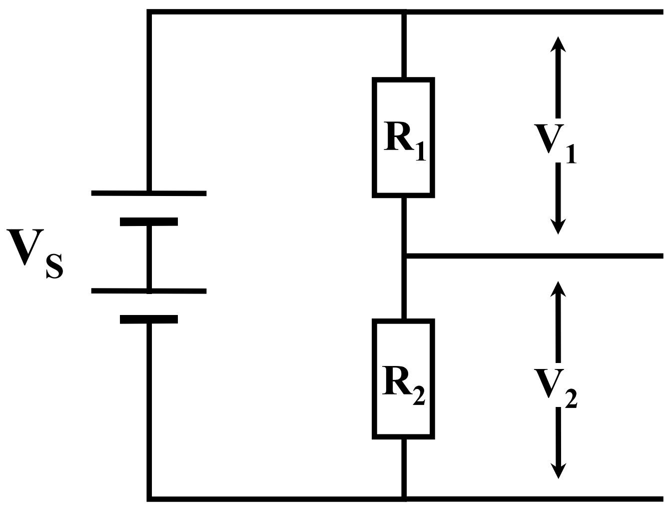
As temperature increases, resistance decreases



capacitor

Voltage across capacitor increases with time

2. The potential divider



Potential divider basics:

1. Both voltages add up to the supply voltage.

$$V_1 + V_2 = V_S$$

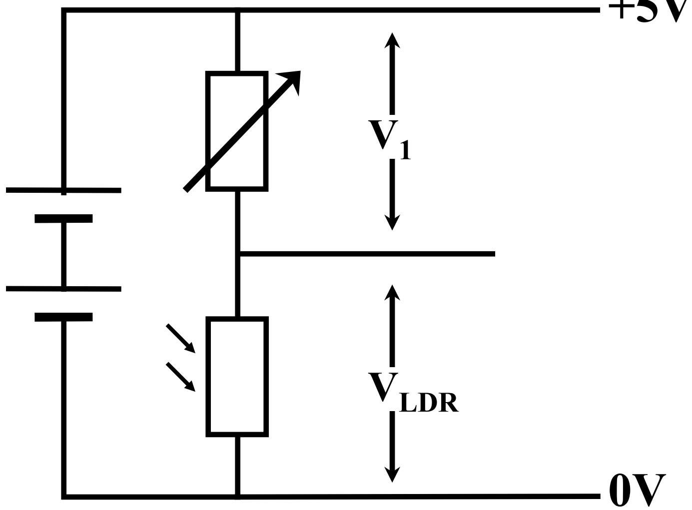
2. The resistor with the largest resistance has the greater voltage across it.

3. If one voltage increases, the other voltage decreases.

These rules still apply when using thermistors, LDR's or capacitors.

Light sensing circuits

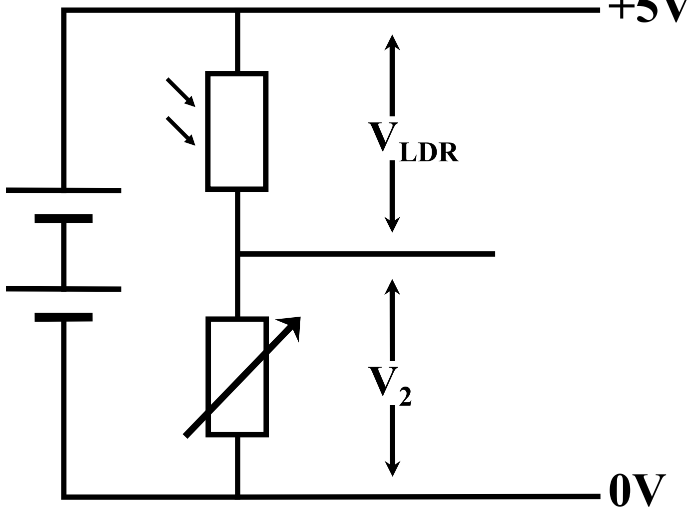
Circuit A



As light is shone on the LDR, its resistance decreases and the voltage across it (V_{LDR}) decreases.

As V_{LDR} decreases, V_1 must increase because $V_{LDR} + V_1 = V_S$ (5V in this case)

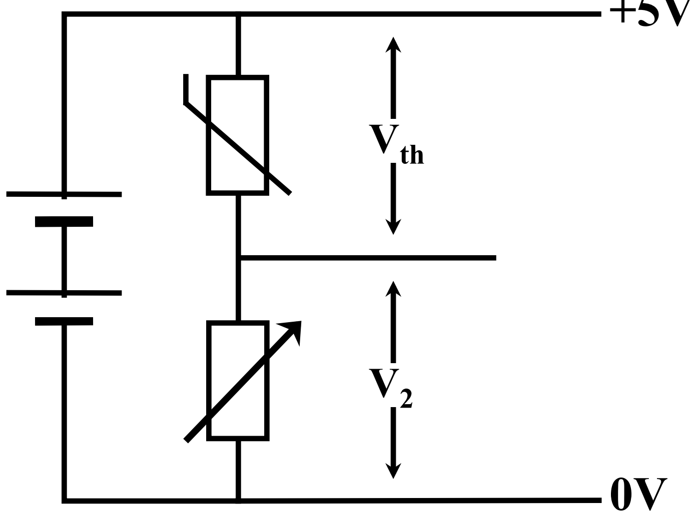
Circuit B



As light is shone on the LDR, its resistance decreases and the voltage across it (V_{LDR}) decreases. Voltage V_2 therefore increases.

Temperature sensing circuits

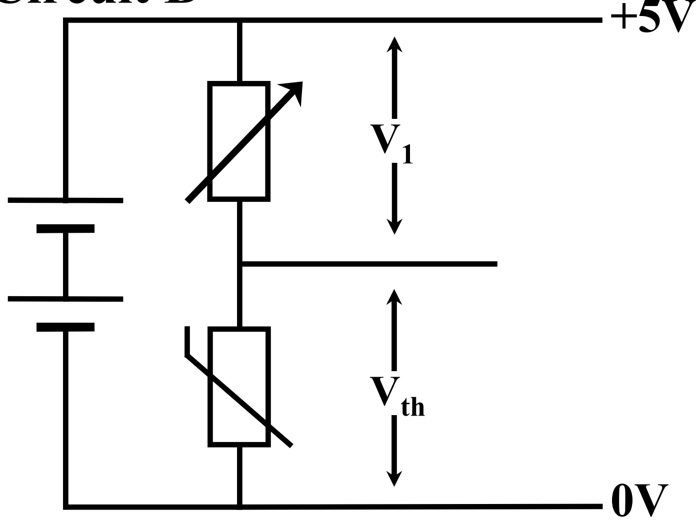
Circuit A



As the thermistor is heated, its resistance decreases and the voltage across it (V_{th}) decreases.

Voltage V_2 therefore increases.

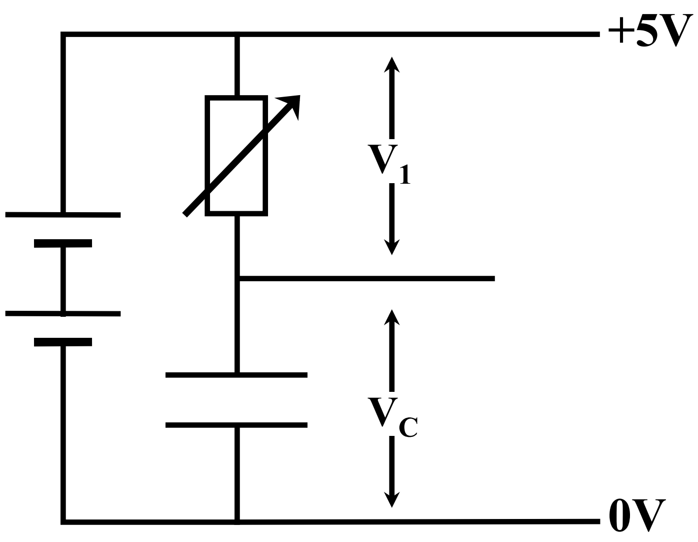
Circuit B



As the thermistor is heated, its resistance decreases and the voltage across it (V_{th}) decreases.

Voltage V_1 therefore increases.

Circuits with capacitors



As the capacitor charges, the voltage across it, V_C increases until it reaches the supply voltage (5V in this case).

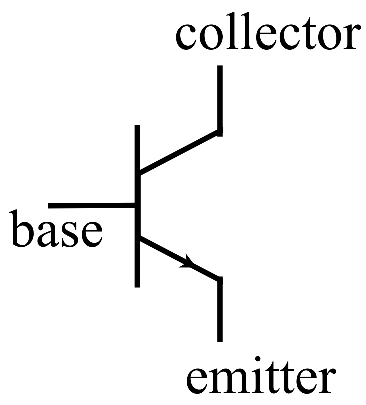
The time for this to happen (time to charge the capacitor) can be increased in two ways:

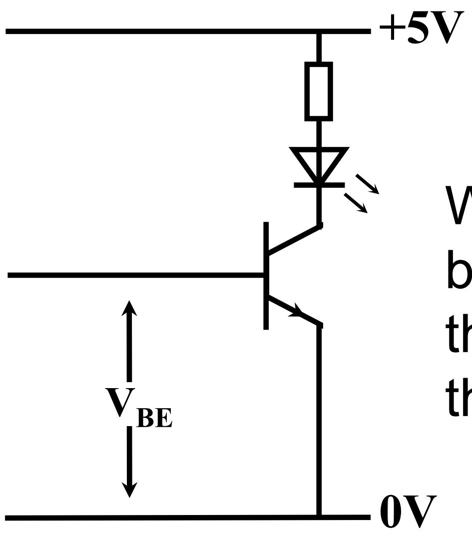
Increase the capacitance of the capacitor

Increase the resistance of the resistor

3. The transistor

The names of the three terminals of a transistor must be remembered.

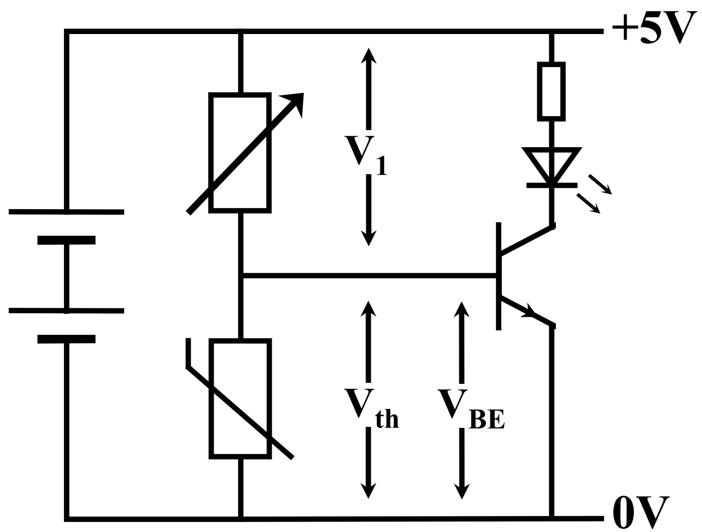




When the voltage between the transistor's base and emitter (V_{BE}) is above 0.7 volts, the transistor conducts (switches on). In this circuit, the LED will light at this point.

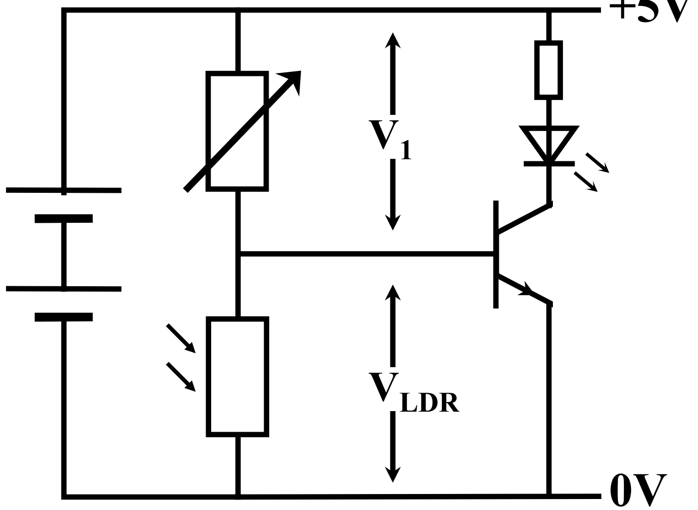
With a potential divider now in the circuit, the voltage across the thermistor, V_{TH} equals V_{BE}. If V_{TH} rises above 0.7 volts, the transistor conducts and the LED will light.

In all the following circuits, V_{BE} will be the voltage across the bottom component.



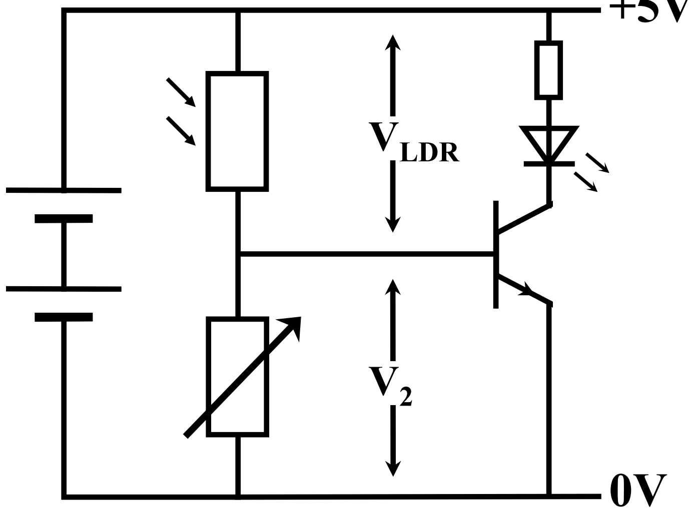
Light sensing circuits

Circuit A



As the LDR is placed in darkness, its resistance increases and the voltage across it (V_{LDR}) increases. If voltage V_{LDR} rises above 0.7 Volts, the transistor will conduct (come on) and the LED will light.

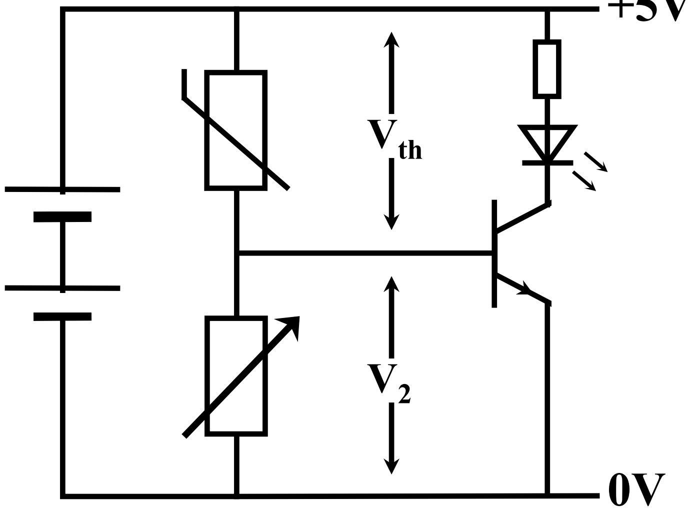
Circuit B



As light is shone on the LDR, its resistance decreases and the voltage across it (V_{LDR}) decreases. Voltage V_2 therefore increases. If voltage V_2 rises above 0.7 Volts, the transistor will conduct (come on) and the LED will light.

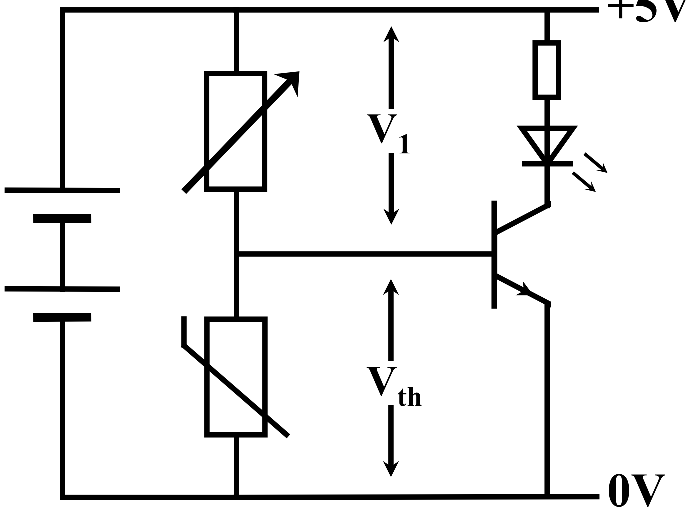
Temperature sensing circuits

Circuit A



As the thermistor is heated, its resistance decreases and the voltage across it (V_{th}) decreases. Voltage V_2 therefore increases. If voltage V_2 rises above 0.7 Volts, the transistor will conduct (come on) and the LED will light.

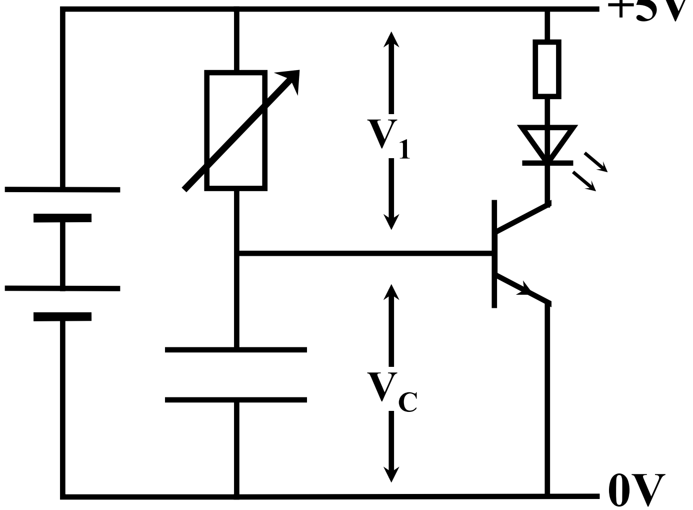
Circuit B



As the thermistor is cooled, its resistance increases and the voltage across it (V_{th}) increases. If voltage V_{th} rises above 0.7 Volts, the transistor will conduct (come on) and the LED will light.

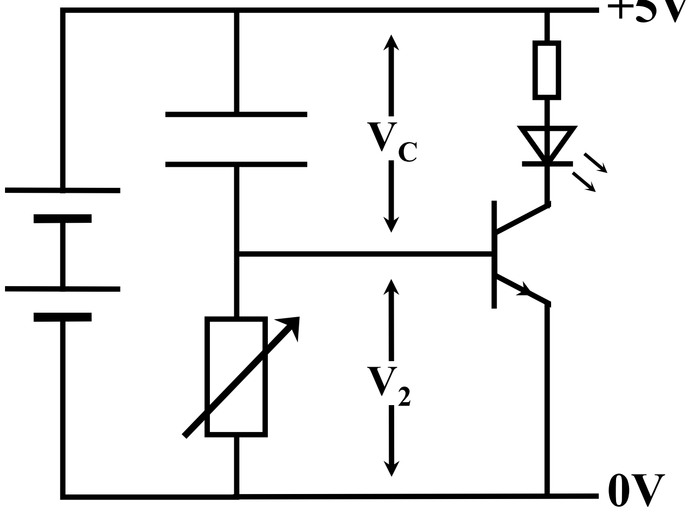
Circuits with capacitors

Circuit A



With the capacitor initially uncharged, the voltage across it, V_C=0 volts. As it charges, V_C increases. When V_C rises above 0.7 Volts, the transistor will conduct (come on) and the LED will light. V_C will eventually reach 5 volts (the supply voltage).

Circuit B



With the capacitor initially uncharged, the voltage across it, V_C=0 volts. As it charges, V_C increases. This causes V_2 to decrease. When V_2 decreases below 0.7 Volts, the transistor will no longer conduct (will switch off) and the LED will not light. V_C will eventually reach 5 volts (the supply voltage). V_2=0V at this point.