



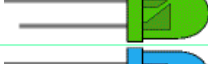

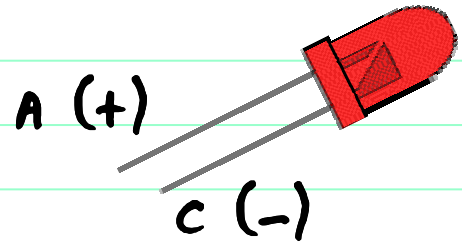


Engineering note: leds and how to use them

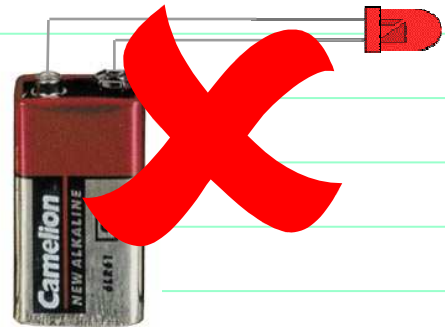
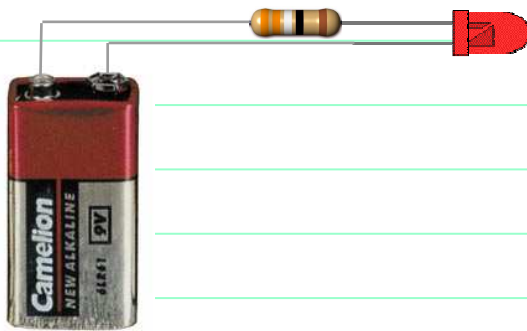
Leds feature a specific voltage drop, depending on type and colour:

	1.7v
	2v
	2v
	2v
	3..4v
	3..4v

check the datasheet for exact voltage drop and rated current !



Always use a series resistor:



How to calculate the series resistor:

Example: operate a red led (1.7v) on a 9vdc source.

Required led current for full brightness: 5mA

(this can be found in the datasheet of the led)

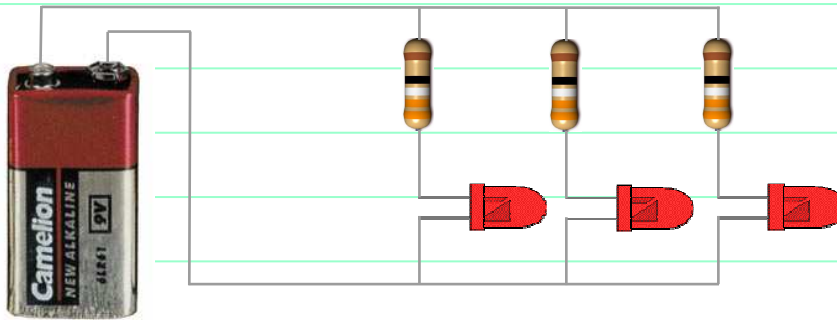
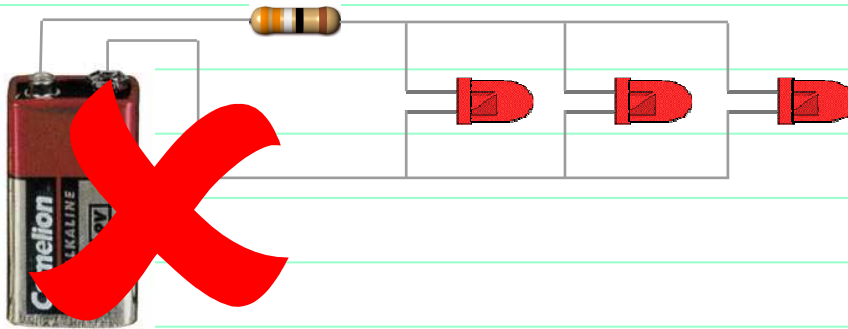
Solution: $(\text{supply voltage} - \text{led voltage}) / \text{required current} = \text{series resistance in ohms}$

$(9 - 1.7) / 0.005 = 1460$ (closest value : use a 1k5 resistor)

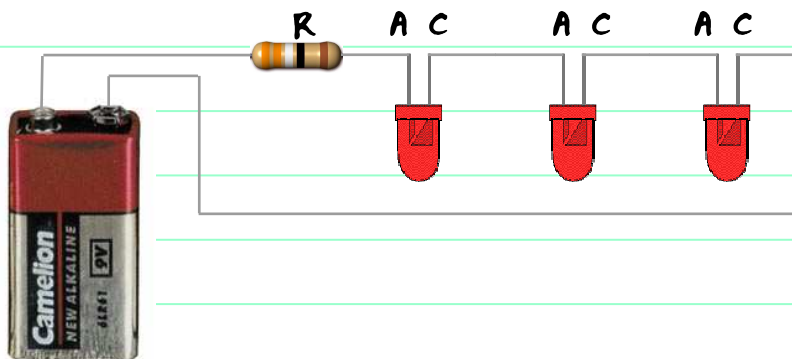
Required resistor power handling = voltage over resistor x current passed through resistor

$(9 - 1.7) \times 0.005 = 0.036\text{w}$ (a standard 1/4w resistor will do the job)

Never connect leds in parallel without series resistor !



LEDs in series:



How to calculate the series resistor:

Example: 3 x red led (1.7v) on 9v battery

Required led current for full brightness: 5mA

(this can be found in the datasheet of the led)

solution: $(\text{supply voltage} - \text{number of leds} \times \text{led voltage}) / \text{required current} = \text{series resistance in ohms}$

$(9 - 3 \times 1.7) / 0.005 = 780$ (use an 820 ohm resistor)

Engineering note: power leds do's and dont's



Do:

Screw the led firmly onto an appropriate heatsink

Use a series resistor or current limit circuit

Don't:

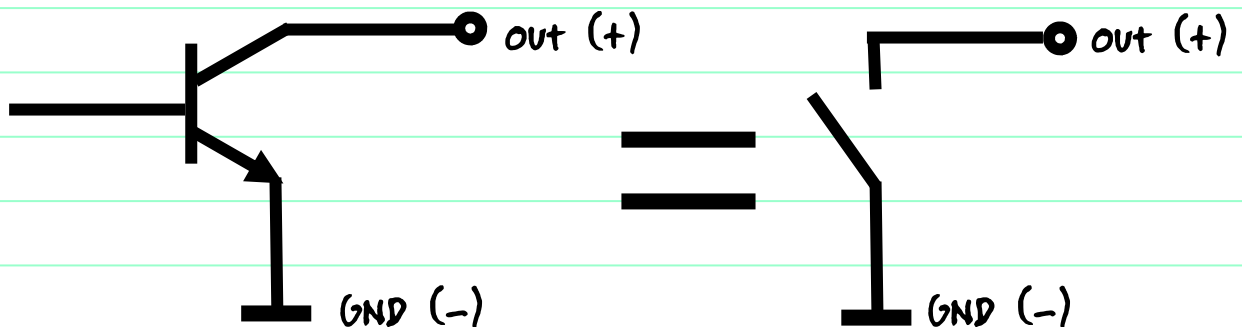
use the led without a heatsink !

use the led beyond the max. operating current

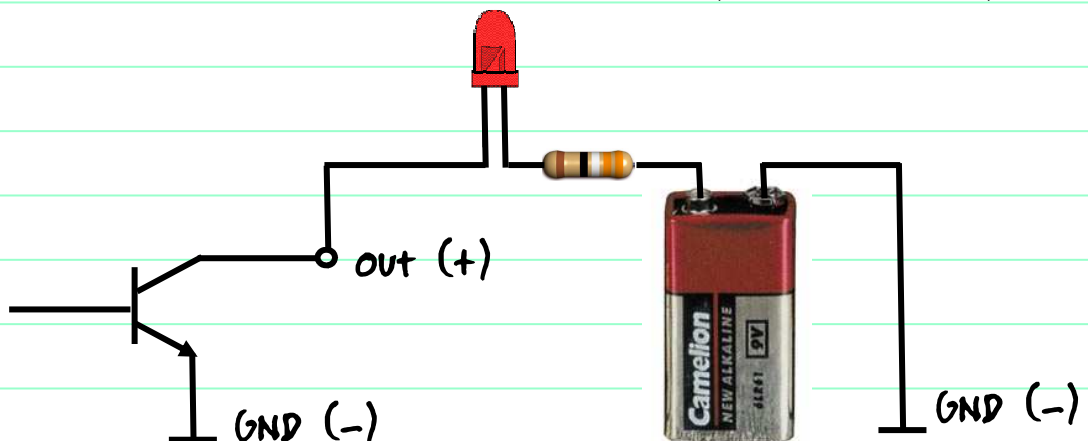
Look directly into the lightsource

Engineering note: open collector outputs

An open collector output can be compared to a switch which switches to ground when operated



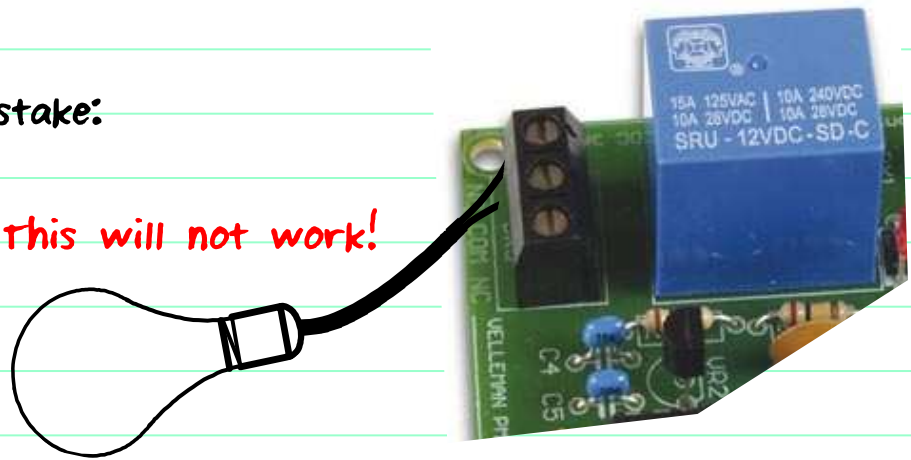
Example: How to switch an LED by means of an open collector output



Engineering note: Relay contacts and how to use

common mistake:

This will not work!



Remember: Relay outputs are switches i.e. There is NO voltage coming out of them. You have to apply an external source.

So, how do you connect a load to a relay output:

