

Little Games with Semiconductors

Guessing Game

- Material:
- 1 wooden board with springs and thumbtacks
 - 4 resistors (2 times $130\ \Omega$; 2 times $18\ \text{k}\Omega$)
 - 2 transistors
 - 2 same colour LEDs
 - 1 trimmer $1\ \text{k}\Omega$ (variable resistor)
 - pair of alligator clips
 - 1 4.5 V battery

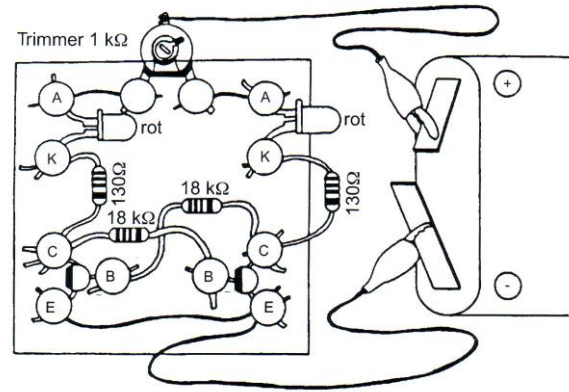
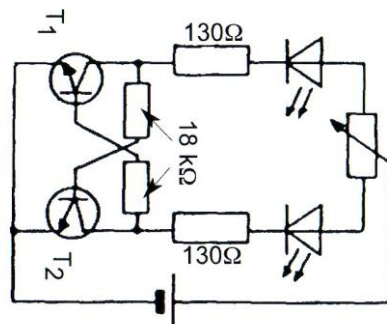
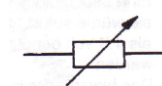


Figure 1

Build the circuit as shown in Figure 1. **Pay attention to the correct connection of the transistors!!** What do you observe?

Remove the battery from the circuit. Now change the resistance by turning the trimmer and then reconnect the battery. Repeat this a few times. Open and close the circuit a few times by changing the trimmer setting. What happens?

Draw the circuit diagram of this circuit. Use the symbols of the electronic components. For the trimmer you have to use the following symbol:



Explain what is happening in this circuit. Track the current path from one pole of the battery to the other. Describe exactly how the transistors work.

Where do you find such circuits in everyday life?

Flip-Flop

The flip-flop circuit is a basic circuit of computer technology. It represents an "electronic memory" that can store the information "LED on" or "LED off".

Material: - 1 wooden board with springs

and thumbtacks

- 4 resistors (2 times $130\ \Omega$;

2 times $18\ \text{k}\Omega$)

- 2 transistors

- 1 green and 1 red LED

- 1 trimmer $1\ \text{k}\Omega$ (variable resistor)

- pair of alligator clips

- 1 4.5 V battery

- 2 thin wires

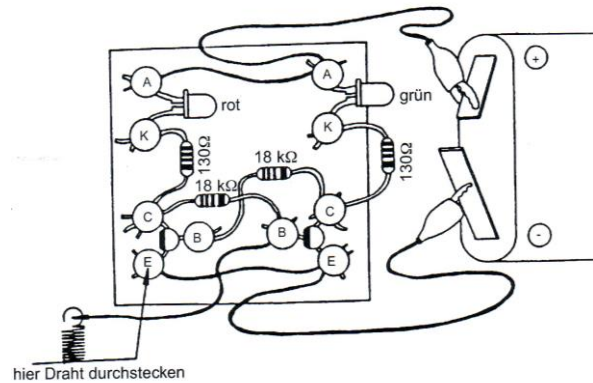


Figure 2

Manual:

Build the circuit as shown in Figure 2. Now you have a game of skill. Take the wire and guide it through the eye of the spring where the emitter of the left transistor (placed behind the red LED) is attached. Be careful not to touch the spring.

What do you observe when the spring is touched?

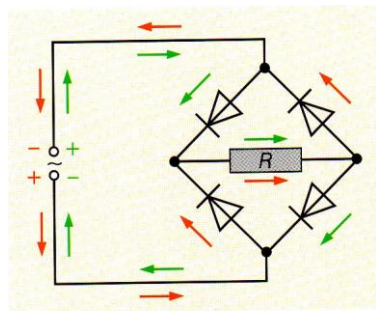
Explain in detail what happens in this circuit when touching the spring with the wire.

Storm warning

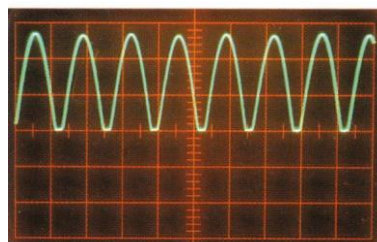
It's thundering! You are sitting comfortably at home and want to read a book. Suddenly a flash of lightning tears through the black sky, then it's dark. Power failure! Unfortunately, you have used all the candles at Christmas, the battery of the flashlight is flat after the last time you went camping and you have not bought replacement yet. Luckily, you remember that in physics lessons, you learned that electricity can be generated with a generator. In the dark you feel your way to your electronics kit. Now your hamster has to go to work: with a few magnets and cables, you will be able to turn your hamster wheel into a generator. To the generator you connect a resistor and a light emitting diode. Although your hamster does a great job, you are not satisfied with the result: the LED flickers.

- a) What happened? (Hint: Think about what the current "looks like" when it comes from the generator.)
- b) Design a circuit that helps you avoid this "problem". You should not change anything at the generator. (Hint: In addition to the LED and the resistor, you will need four diodes)

*Graetz- bridge rectifier circuit
Including the direction of the
electrical current flow*

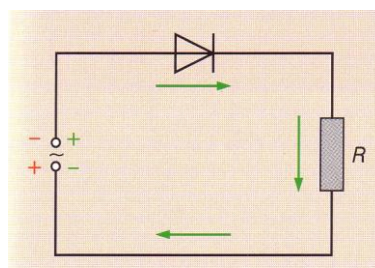


pulsating direct-current voltage



Addition: The half-cycle rectifier

*half-cycle rectifier including the
direction of the electrical current
flow*



Comparison: pulsating DC voltage with half-wave rectification and applied AC voltage:

