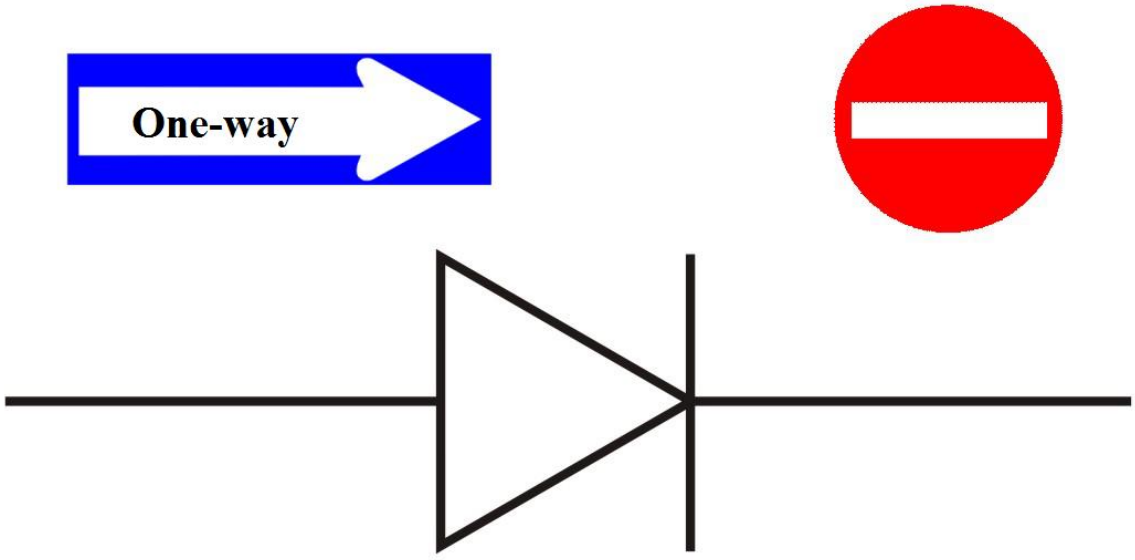
Hand-on Semiconductors

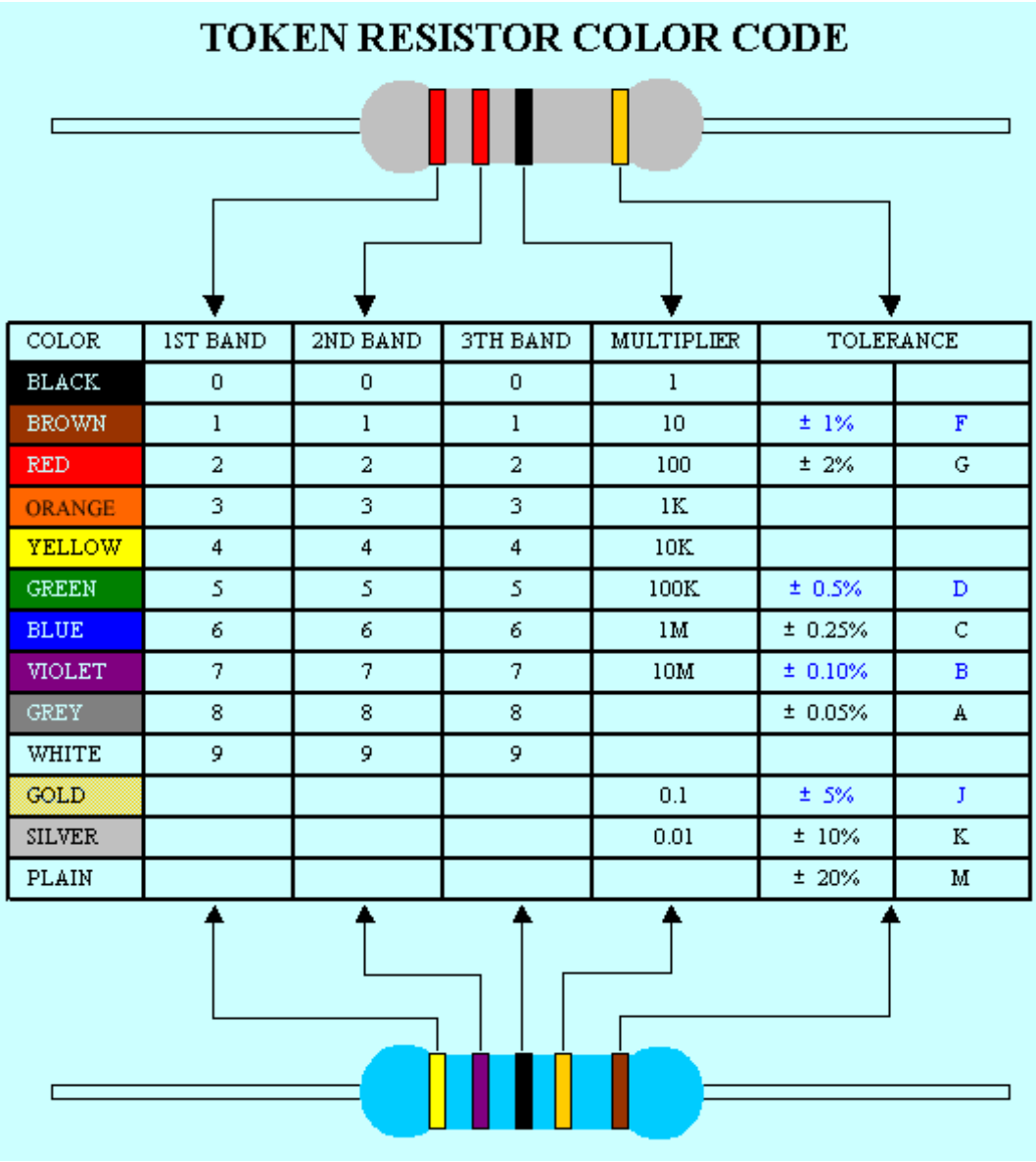
Topic 1: Diodes



Diodes: one-way streets for electrodes

Note:

You will need resistors for the following experiments. You can find the resistance by looking at the colour bands, which are located on the individual resistors. The first two rings give you the first two digits of the resistance value. The third ring tells you what factor these two numbers must be multiplied to get the right value. The last ring tells you the tolerance (error in percent) of the resistor.



COLOR	1ST BAND	2ND BAND	3TH BAND	MULTIPLIER	TOLERANCE	
BLACK	0	0	0	1		
BROWN	1	1	1	10	± 1%	F
RED	2	2	2	100	± 2%	G
ORANGE	3	3	3	1K		
YELLOW	4	4	4	10K		
GREEN	5	5	5	100K	± 0.5%	D
BLUE	6	6	6	1M	± 0.25%	C
VIOLET	7	7	7	10M	± 0.10%	B
GREY	8	8	8		± 0.05%	A
WHITE	9	9	9			
GOLD				0.1	± 5%	J
SILVER				0.01	± 10%	K
PLAIN					± 20%	M

Caution: Semiconductor components are sensitive and therefore usually require a protective resistor!

V1: Material:

- 1 wooden board
- 8 Thumbtacks
- 8 springs
- 1 4.5 V battery
- 2 resistors (130 Ω und 1,8 kΩ)
- 1 LED
- 1 pair of alligator clips

Diagram:

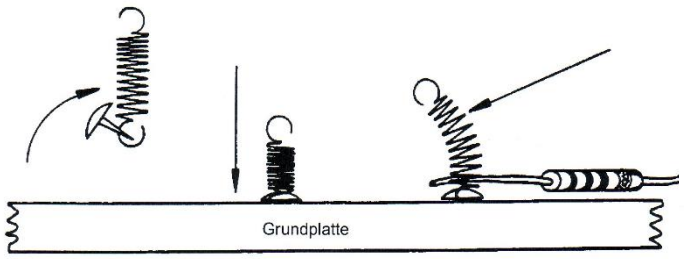


Figure 1

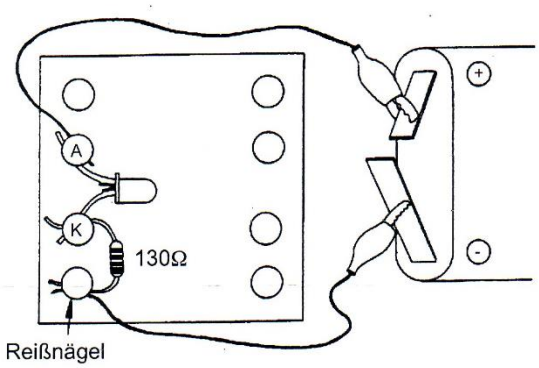


Figure 2

Instructions:

Fasten the springs with the thumbtacks on the wooden plate, as shown in figure 1 and figure 2 (basic structure).

Cut the cable with the crocodile clips in the middle. Remove about 3 cm of the insulation from the cut ends.

Clamp the LED and the 130 Ω resistor in the appropriate places between the springs. Make sure that the shorter leg of the LED is connected to the resistor. Use the crocodile clips to connect the experimental setup to the 4.5 V battery. Pay attention to the correct polarity of the connections! What do you observe?

Now replace the 130 Ω resistor with the 1.8 kΩ resistor. Compare with the first attempt.

Now remove the LED from the experimental setup, turn it over so that the long leg (anode) points to the resistor. What do you observe?

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V2: Material: - Basic construction as in V1
-1 4.5 battery
-1 resistor (130 Ω)
-1 LED
-1 diode
-1 pair of alligator clips

Circuit Diagram:

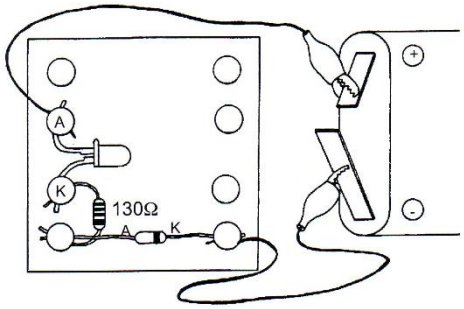

Figure 3

Instructions:

Using the springs on the wooden plate clamp the LED, the 130 Ω resistor and the diode as shown in figure 3. Make sure that the short leg of the light emitting diode (the cathode) faces the resistor. The cathode ring drawn on the diode must point away from the resistor. Connect the circuit to the 4.5 V battery. Pay attention to the polarity of the connections! What happens?

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Now swap the connections of the diode (the ring now points to the resistance). Now what do you observe?

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Result:

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V3: optical call system: material:

- Basic construction as in experiment 1
- 1 4.5 battery
- 2 resistors (130 Ω)
- 2 LEDs
- 1 pair of alligator clips
- 3 wire pieces (ends stripped)

wiring diagram:

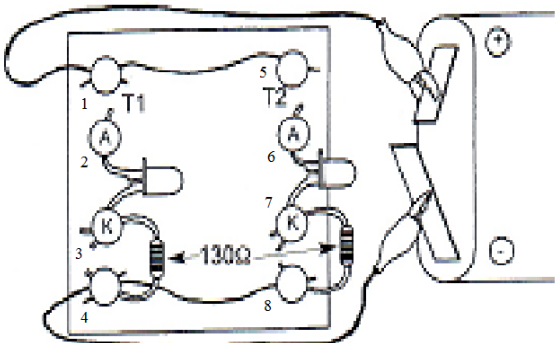

Figure 4

Instructions:

Insert the light-emitting diodes and resistors as shown in Figure 4. The circuit on the left side of the plate is now identical to circuit on the right side (be careful with the connection of the LED!). Use a wire to connect spring 1 and spring 5 and another wire to connect spring 4 and spring 8. If you now touch spring 1 and spring 2 (corresponding to button 1) or spring 5 and spring 6 (corresponding to button 2), LED 1 or LED 2 lights up. Test to see if your circuit works.

Task:

You should now change the circuit in order to illuminate only one LED with button 1 and both LEDs with button 2. (In case you need help, have a look at the hints on the next page)

Draw a circuit diagram of your circuit. You should use the following symbols:

LED: 

Diode: 

Resistor: 

Button: 

Battery: 

Hint 1:

First connect spring 2 and spring 6 with a wire. Now press button 1 first, then button 2. What are you observing?

Hint 2:

You have not yet reached your goal with this circuit. In experiments 1 however, you have already come to know another component that can help you to solve the problem. How should you insert the diode so that your circuit works as desired?

Choose one of the following three experiments and design a suitable circuit. First draw the circuit on a sheet of paper. Show the circuit to your teacher! Build the circuit on the wooden board and check it. Make corrections if necessary. Draw a circuit diagram of the circuit you designed. Use the symbols that you got to know in experiment 3.

V4: Polarity Tester

With a polarity tester, the connections of a DC power source can be examined. The polarity tester is connected to the DC power source with two different colored crocodile clips. Depending on which crocodile clip is connected to which pole, one or the other LED of the polarity tester lights up.

V5: Continuity Tester:

It is not always possible to detect the direction that current should flow in electronic devices and components. The continuity tester makes it possible to determine this direction in an existing circuit. The continuity tester is attached with crocodile clips to each end of the component/device to be tested. The component/device should not be connected to a power source! If the continuity tester is connected in the forward correct direction, an LED lights up. If it is connected in the reverse direction, the LED does not light up.

V6: Protection against reverse polarity of batteries.

Electrical equipment may become defective if batteries are inserted in reverse. With the help of a protective device you can prevent this. If the battery is inserted incorrectly, an LED will light up as a warning.