Temperature control of a transistor (Item No.: P1378800)

Curricular Relevance

<table>
<thead>
<tr>
<th>Area of Expertise:</th>
<th>Education Level:</th>
<th>Topic:</th>
<th>Subtopic:</th>
<th>Experiment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physik</td>
<td>Klasse 10-13</td>
<td>Elektrizitätslehre</td>
<td>Elektronik</td>
<td>Temperatursteuerung eines Transistors</td>
</tr>
</tbody>
</table>

Difficulty: Intermediate

Preparation Time: 10 Minutes

Execution Time: 10 Minutes

Recommended Group Size: 2 Students

Additional Requirements: Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional information

The resistance value of an NTC resistor is dependent on the temperature. In this experiment, a circuit is examined in which a transistor is triggered with an NTC resistor and switches a filament lamp on and off. The NTC resistor, the potentiometer and the 10 kΩ resistor form a temperature dependent potential divider, from which the control voltage of a transistor is picked up. In order to realise both a light circuit and a dark circuit without a relay, the NTC resistor is inserted at various positions in the potential divider.

Notes on setup and procedure

The voltage applied should be 4 V to be sure that the experiment will work properly, whereby it is recommended that the voltage is first measured at the power supply. A hair-drier is used to heat the NTC resistor because it produces a uniform, strong heat. As the heating procedure here is only very short, the one hair-drier can be simply passed from one group of students to the next.

Remarks

The circuit used has no genuine switch characteristics, instead there is an indistinct transition from one switch condition to the other. This becomes particularly clear on slowly changing the temperature. A genuine switching behaviour could be reached by having the transistor trigger a relay, that then switches the lamp.
Temperature control of a transistor  (Item No.: P1378800)

Task and equipment

Task

How does a transistor temperature switch work?

Examine how a transistor can be triggered with a temperature dependent resistor to switch a lamp.
# Equipment

<table>
<thead>
<tr>
<th>Position No.</th>
<th>Material</th>
<th>Order No.</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Straight connector module, SB</td>
<td>05601-01</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Angled connector module, SB</td>
<td>05601-02</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>T-shaped connector module, SB</td>
<td>05601-03</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Interrupted connector module, SB</td>
<td>05601-04</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Junction module, SB</td>
<td>05601-10</td>
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<td>Socket module for incandescent lamp E10, SB</td>
<td>05604-00</td>
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<td>7</td>
<td>Resistor module 1 kOhm, SB</td>
<td>05614-10</td>
<td>1</td>
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<tr>
<td>8</td>
<td>Resistor module 10 kOhm, SB</td>
<td>05615-10</td>
<td>1</td>
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<td>9</td>
<td>Potentiometer module 10 kOhm, SB</td>
<td>05625-10</td>
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<td>10</td>
<td>NTC-resistor module, SB</td>
<td>05630-01</td>
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<td>NPN transistor module BC337, SB</td>
<td>05656-00</td>
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<td>12</td>
<td>Connecting cord, 32 A, 500 mm, red</td>
<td>07361-01</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>Connecting cord, 32 A, 500 mm, blue</td>
<td>07361-04</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>Filament lamps 4V/0.04A, E10, 10</td>
<td>06154-03</td>
<td>1 piece</td>
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<td>15</td>
<td>PhyWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A</td>
<td>13506-93</td>
<td>1</td>
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<td>16</td>
<td>Multi-range meter, analogue</td>
<td>07028-01</td>
<td>1</td>
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<td>Hot/cold air blower, 1800 W</td>
<td>04030-93</td>
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<td></td>
<td>Flashlight, w/o battery, medium</td>
<td>08164-00</td>
<td>1</td>
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<tr>
<td></td>
<td>Battery cell, 1.5 V, baby size, type C</td>
<td>07922-01</td>
<td>2</td>
</tr>
</tbody>
</table>
Set-up and procedure

Set-up

Set up the experiment as shown in Fig. 1 and Fig. 2; connect the voltmeter first to the power supply; select the 10 V measurement range.

![Fig. 1](image1.png)

![Fig. 2](image2.png)
Procedure

- Switch on the power supply unit; set the voltage to 4 V.
- Connect the voltmeter parallel to the NTC resistor, select the 1 V measurement range.
- Vary the potentiometer setting; observe the voltage at the NTC resistor and the lamp; record your observations under Result - Observations 1 in the report.
- Set the potentiometer so that the lamp just lights up brightly.
- Warm the NTC resistor with your hand.
- Observe the lamp and the voltage; record your observations under Result - Observations 2.
- Heat the NTC resistor with a hot hair-drier distanced about 5 cm from it.
- Record your observations and measurements under Result - Observations 3.
- Switch off the power supply unit.
- Set up the experiment as shown in Fig. 3 and Fig. 4; switch on the power supply unit.
- Vary the potentiometer setting; observe the voltage at the NTC resistor and the lamp; record your observations under Result - Observations 4.
- Set the potentiometer so that the lamp just lights up brightly.
- Proceed further with the experiment as above; record your observations and measurements under Result - Observations 5.
Report: Temperature control of a transistor

Result - Observations 1

Note your observations.

Result - Observations 2

Note your observations.
Result - Observations 3

Note your observations.

Result - Observations 4

Note your observations.
Result - Observations 5

Note your observations.

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Evaluation - Question 1

How does the value of the resistance change when the temperature of an NTC resistor changes?

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Evaluation - Question 2
Why does the lamp no longer shine when the NTC resistor is in the lower part of the potential divider (Fig. 1) and is heated?

Evaluation - Question 3
Why does the lamp light up when the NTC resistor is in the upper part of the potential divider (Fig. 3) and is heated?