

Temperature regulation with Cobra SMARTsense Code



Physics

Energy

Energy forms, conversion & conservation



Difficulty level

easy



Group size

1



Preparation time

10 minutes



Execution time

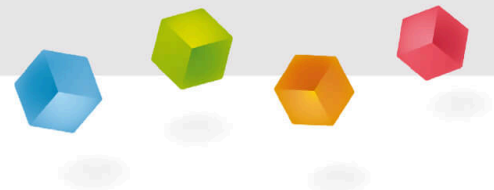
10 minutes

This content can also be found online at:



<https://www.curriculab.de/c/6a423c3a7862c80002f85bdd>

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Teacher information

Application

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Experimental setup

A Peltier element, with a beaker of water placed on top of it, can be used to maintain the water at a constant temperature. Both the water and the Peltier element are fitted with temperature sensors. A Code device with a relay is connected in series with the Peltier element and controls the circuit so that the Peltier element heats or cools as required. Depending on the temperature, the Code displays a happy or sad smiley face.

One example of an application is a mini-fridge, which maintains the temperature of drinks at a pre-programmed setting.

Other teacher information (1/2)

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Prior knowledge



Pupils should be familiar with the basics of an electrical circuit, as well as with how a Peltier element and a relay work.

Principle



The Peltier element is used to maintain the water at a constant temperature. A control unit regulates the Peltier element by switching the circuit on or off depending on the temperature of the sensor in the water. This allows the Peltier element to cool the water in order to maintain the desired temperature.

Other teacher information (2/2)

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Learning objective



Pupils should understand how a Peltier element works and how it can be used for temperature control. They will learn how temperature measurement, current control and programming work together to maintain a constant temperature.

Tasks



1. Build a circuit to regulate the temperature of water
2. Program the control of a Peltier element
3. Watch as the water is cooled to a specific temperature

Safety instructions

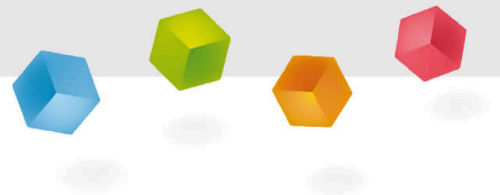
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The general guidelines on safe experimentation in science lessons apply to this experiment.

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Student information



Motivation

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Chilled lemonade

Have you ever wondered how to get a drink to the perfect drinking temperature in summer?

That's exactly what you can experience with this experiment! Using a Peltier element and temperature sensors, you'll learn how technology can ensure that the temperature of a drink remains constant – whether you want it to be warm or cold. Discover for yourselves how such systems could also be used in fridges or hotplates. Best of all: at the end, you'll see exactly whether the temperature is 'just right' – because a smiley face will tell you whether the drink has reached the selected temperature.

Tasks

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Experimental setup

1. Construct a circuit for regulating the temperature of water
2. Programm the control of a Peltier element
3. Observe how the water is cooled to a specific temperature

Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Code - Output device for switching relays, LEDs, display	12953-00	1
2	Cobra SMARTsense Temperature - Sensor for measuring temperature -40 ... 125 °C (Bluetooth)	12903-00	2
3	Thermal generator for student experiments	05770-00	1
4	PHYWE Mobile power supply to go, rechargeable DC 0...12 V / 0...2A	13510-99	1
5	Connecting cord, 32 A, 250 mm, red	07360-01	1
6	Beaker, aluminum, polished	05903-01	1
7	Support base, separable for 2 rods	02001-00	1
8	Boss head	02043-00	1
9	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
10	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
11	Holder for Cobra SMARTsense	12960-00	1
12	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

Setup (1/4)

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To measure temperatures, you will need the Cobra SMARTsense sensors and the measureAPP. The app can be downloaded free of charge from the App Store – see below for QR codes. Check that Bluetooth is enabled on your device (tablet, smartphone).



measureAPP for Android operating systems



measureAPP for iOS operating systems



measureAPP for tablets / PCs running Windows 10

Setup (2/4)

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Setting up the tripod

Set up the tripod.

To do this, secure the tripod pole vertically in the tripod base.

Attach a boss head to the tripod pole.

Clamp a second tripod pole horizontally into the fitted boss head.

The temperature sensor holder is attached to the free end of the horizontal tripod pole.

Setup (3/4)

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Experimental setup

The Peltier element is on the table.

Place a small plastic cup filled with a little water on top of the Peltier element.

Attach a temperature sensor to the Peltier element.

Clip a second temperature sensor onto the holder on the tripod and dip the end into the liquid in the beaker.

Setup (4/4)

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Experimental setup

Set up the circuit for the experiment as shown in the adjacent diagram.

When doing so, connect the circuit to relay 1 of the code so that the code and the Peltier element are connected in series.

Make sure that the Peltier element is connected in such a way that it cools when current flows through it.

Setup (4/4)

PHYWE



Experimental setup

Set up the circuit for the experiment as shown in the adjacent diagram.

When doing so, connect the circuit to relay 1 of the code so that the code and the Peltier element are connected in series.

Make sure that the Peltier element is connected in such a way that it cools when current flows through it.

Procedure (1/6)

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Cobra SMARTsense Temperature

Switch on the Cobra SMARTsense temperature sensor, which measures the water temperature. To do this, press and hold the button on the sensor for 3 seconds.

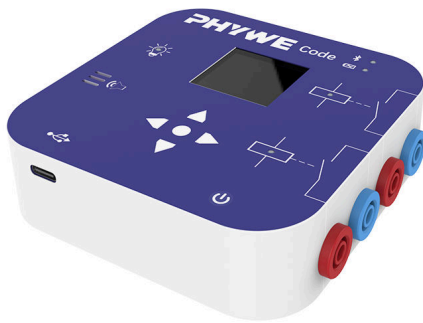
Open the measure app on your tablet or smartphone and make sure that the device can connect to Bluetooth devices.

Select the "Cobra SMARTsense Temperature" sensor.

The second temperature sensor will only be connected to the measureAPP at a later stage.

Procedure (2/6)

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Cobra SMARTsense Code

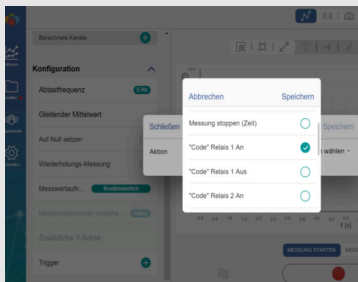
Switch on your Cobra SMARTsense Code by pressing and holding the button on the sensor for 3 seconds.

Open the measureAPP on your tablet or smartphone and make sure that the device can connect to Bluetooth devices.

Select the "Cobra SMARTsense Code" sensor.

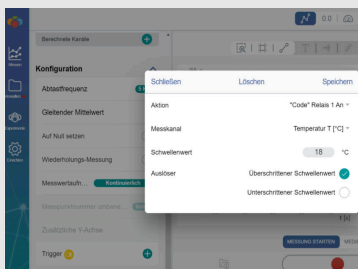
Procedure (3/6)

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Program the Cobra SMARTsense code by selecting the code's actions under 'Trigger' in the measureAPP.

Select 'Code' as the action for Relay 1 On and temperature T [°C] as the measurement channel.

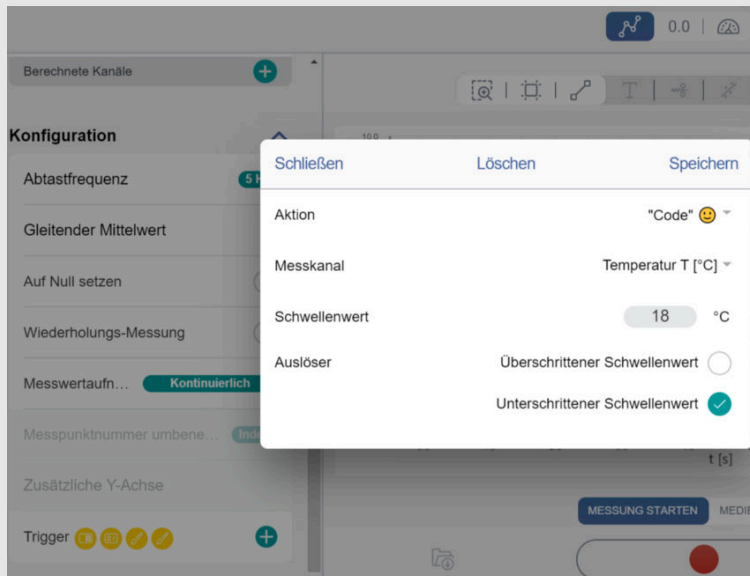


Set the threshold to 18°C and tick the box for 'threshold exceeded'

Repeat this process and programme the 'Code' relay 1 so that it switches off when the temperature falls below the threshold value of 18°C.

Procedure (4/6)

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We are now programming the visual feedback using smileys.

Under 'Trigger', select 'Code' as the action :) and temperature T [°C] as the measurement channel.

Set the threshold to 18°C and tick the box for 'below threshold'

Repeat this process and programme the code so that it displays a sad smiley face when the threshold of 18°C is exceeded.

Procedure (5/6)

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Cobra SMARTsense Temperature

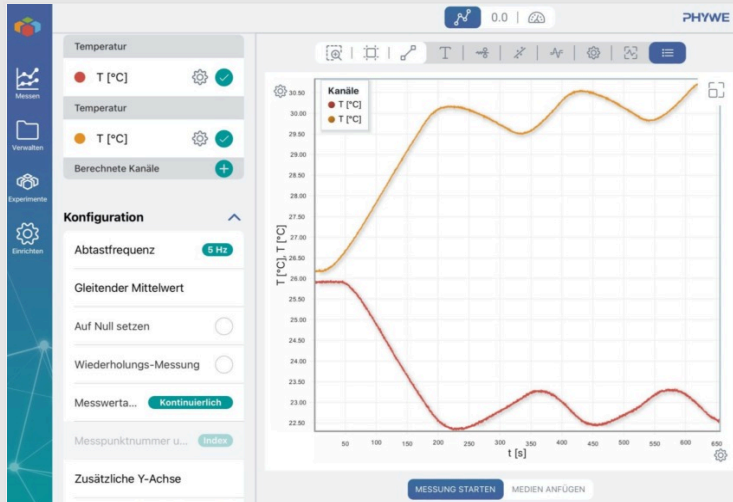
Now connect the second Cobra SMARTsense temperature sensor. To do this, press and hold the button on the sensor for 3 seconds.

Open the measureAPP on your tablet or smartphone and make sure that the device can connect to Bluetooth devices.

Select the "Cobra SMARTsense Temperature" sensor.

Procedure (6/6)

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Measurement with a threshold value of 23°C

Start a measurement.

The graph on the left was recorded using a threshold value of 23°C.

Can you produce a similar graph with a threshold value of 18°C?

Watch as the liquid slowly cools to the desired temperature.

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Report

Task 1

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How are the individual components in the system linked together?

If the Code device displays a smiling smiley face, the water has reached the desired temperature. The relay is , the current , and the Peltier element . If the Code device displays a sad smiley face, the water temperature is too high. The relay is , the current and the Peltier element .

☒ Check

Task 2

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Can the current circuit be modified so that the Peltier element heats rather than cools? Select all the correct statements:

☐ Swapping the wires on the Peltier element causes the Peltier element to heat up.☐ It is not possible to use a Peltier element for heating.☐ Swapping the wires on the Cobra SMARTsense Code causes the Peltier element to heat up.☐ Swapping the wires on the power supply causes the Peltier element to heat up.☒ Check