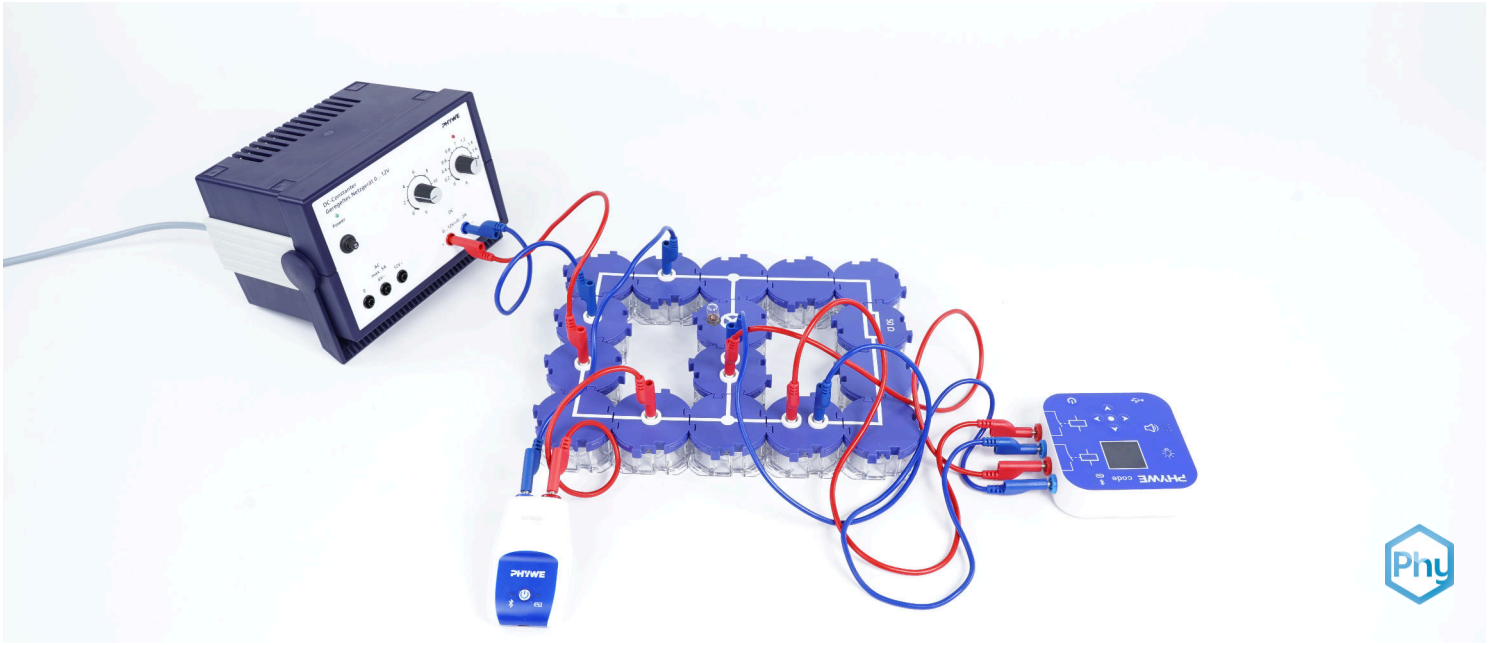
Automatic surge protection with Cobra SMARTsense Codeiode



Physics > Electricity & Magnetism > Electric current & its effects

Difficulty level	Group size	Preparation time	Execution time
easy	-	10 minutes	10 minutes

This content can also be found online at:

https://www.curriculab.de/c/67dd22da4fbc820002da543e

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Teacher Information

Application

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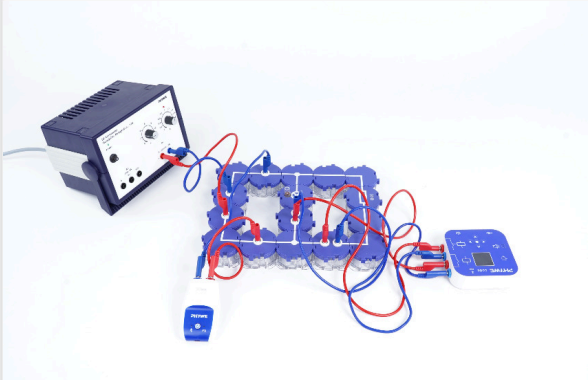

Experimental setup

Electrical appliances have a maximum voltage and current at which they can operate. If these values are exceeded, the current can severely damage the respective devices. Such voltage fluctuations can be caused by various issues. For example, switching large machines on and off can alter the voltage of other devices.

To prevent potential damage to components, overvoltage protection circuits are installed. These circuits automatically detect excessive voltage and switch to an alternative circuit to protect the component. In this experiment, you will build such a circuit yourself.

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Other teacher information (1/2)

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Prior knowledge

Students should know how to measure voltages and be familiar with the flow of current in parallel circuits.

Principle

A voltage U is applied to a light bulb and gradually increased by hand while being measured simultaneously. Two circuits are connected to the mains voltage: One circuit with the light bulb and one with a resistor. The Cobra SMARTsense device is connected and configured to measure the mains voltage, directing the voltage to the resistor when $U > 6\ \mathrm{V}$ and to the light bulb, when $U < 6\ \mathrm{V}$.

Other teacher information (2/2)

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Learning objective

The students should learn how a surge protection circuit works and be introduced to programming with the Cobra SMARTSense code.

Tasks

The students set up the circuit according to the task description. They then configure the SMARTsense code correctly. Afterwards, they test the circuit and, if necessary, make additional adjustments to the SMARTsense code.

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Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

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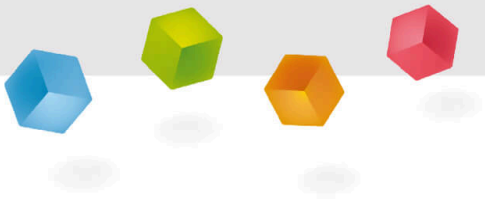

Student Information

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Motivation

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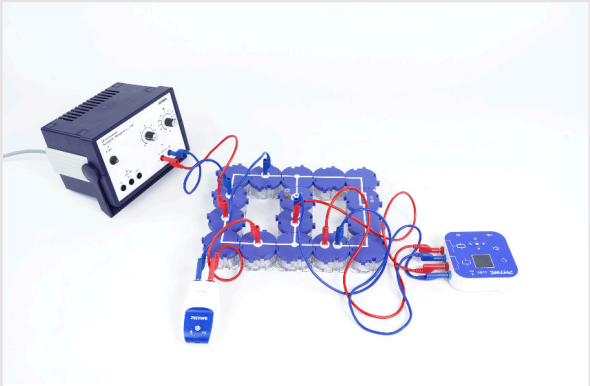

Experimental setup

Electrical appliances have a maximum voltage and current at which they can operate. If these values are exceeded, the resulting current can severely damage the devices. Such voltage fluctuations can be caused by various factors. For example, switching large machines on and off can alter the voltage of other devices.

To prevent potential damage to components, overvoltage protection circuits are installed. These circuits automatically detect excessive voltage and switch to an alternative circuit to protect the component. In this experiment, you will build such a circuit yourself.

Tasks

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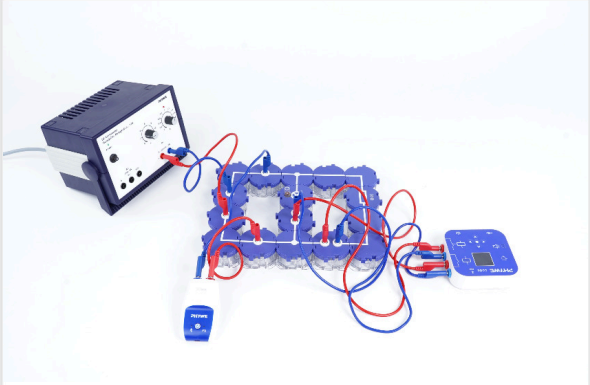

Experimental setup

1. Build the circuit according to the task
2. Set up the SMARTsense code correctly
3. Test the circuit and set up any additional settings on the SMARTsense code

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Code - Output device for switching relays, LEDs, display	12953-00	1
2	Cobra SMARTsense Voltage - Sensor for measuring electrical voltage ± 30 V (Bluetooth + USB)	12901-01	1
3	Angled connector module, SB	05601-02	4
4	T-shaped connector module, SB	05601-03	2
5	Interrupted connector module with sockets, SB	05601-04	2
6	Junction module, SB	05601-10	2
7	Socket module for incandescent lamp E10, SB	05604-00	1
8	Resistor module 50 Ohm, SB	05612-50	1
9	Straight connector module with socket, SB	05601-11	2
10	Straight connector module, SB	05601-01	2
11	Connecting cord, 32 A, 250 mm, red	07360-01	2
12	Connecting cord, 32 A, 250 mm, blue	07360-04	2
13	Connecting cord, 32 A, 500 mm, red	07361-01	2
14	Connecting cord, 32 A, 500 mm, blue	07361-04	2
15	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
16	PHYWE Power supply, universal, analog display DC: 18 V, 5 A / AC: 15 V, 5 A	13503-93	1
17	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Setup (1/5)

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To measure with the **Cobra SMARTsense sensors**, the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the respective app store (QR codes below). Please check that **Bluetooth is enabled** on your device (smartphone, tablet, desktop PC) before starting the app.

measureAPP for Android operating systems

measureAPP for iOS operating systems

measureAPP for tablets / PCs with Windows 10

Setup (2/5)

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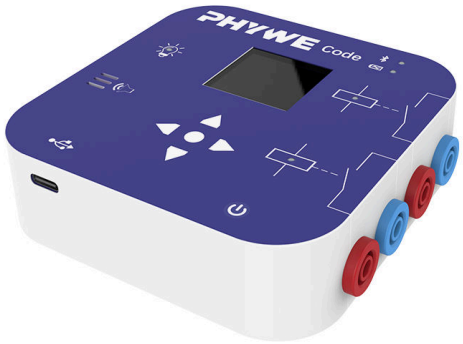

Cobra SMARTsense Code

- In this experiment, you will use the Cobra SMARTsense device. This is a control unit capable of outputting specific signals.
- Possible signal forms include, for example, the illumination of an LED, a display indication, or a sound.
- In this experiment, we will use the relay control of the Cobra SMARTsense device. In this context, a relay functions as nothing more than a switch. It can be used to open and close circuits in a targeted manner.

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Set-up (3/5)

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- Build the circuit diagram as shown in Figure 1.
- Connect the switched-off power supply unit.

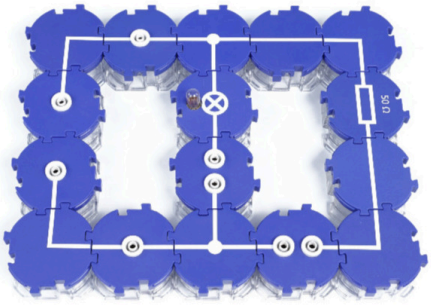

Fig. 1 Circuit of the experiment

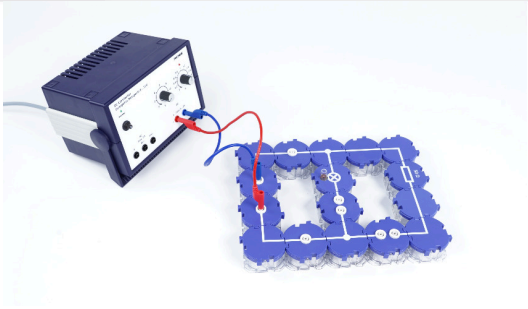

Fig. 2 Connecting the power supply unit

Setup (4/5)

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- Connect the top two connections of the Cobra SMARTSense code below the light bulb. The top two connections are the ones at the height of the PHYWE logo. (Fig. 3)
- Connect the two lower connections to the resistor circuit. (Fig. 4)

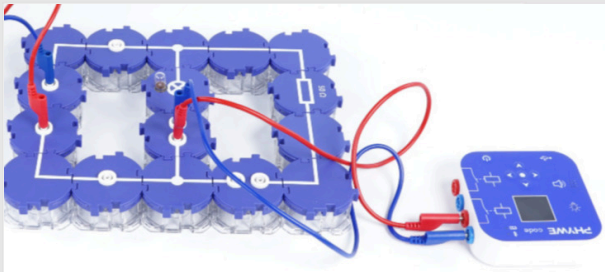

Fig. 3

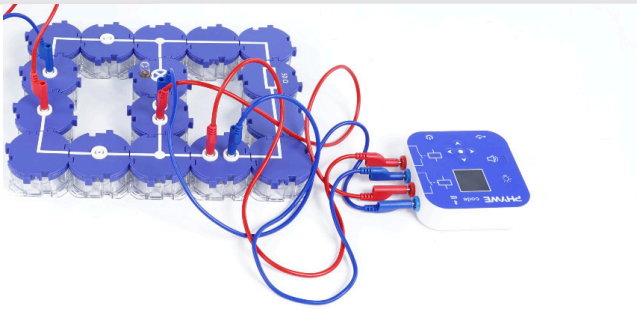

Fig. 4

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Setup (5/5)

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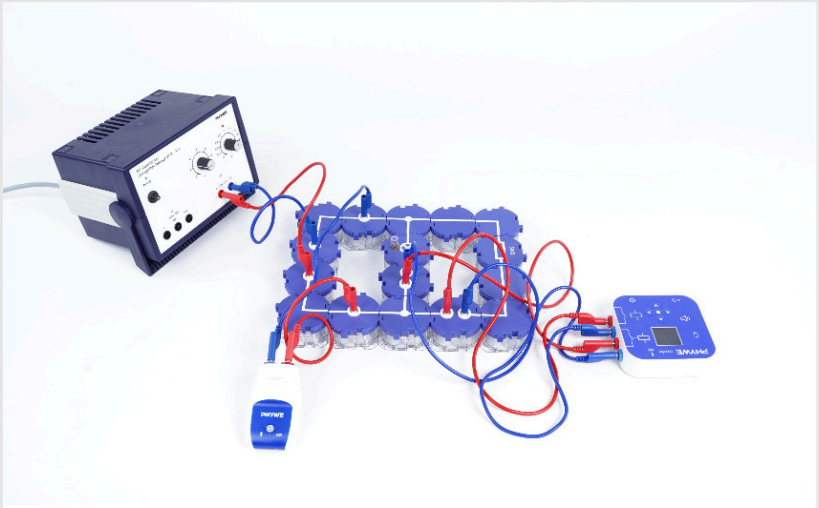

Fig. 5 Experimental setup

- Now connect the voltage sensor so that it surrounds both the light bulb and the resistor.

Procedure (1/8)

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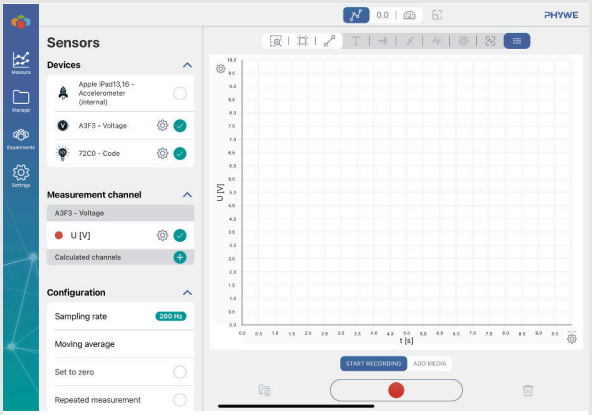

Fig. 6 Connecting the sensors

- Now switch on the two sensors by pressing and holding the on/off button for three seconds.
- Open the MeasureAPP and connect to both sensors.
- Relay 1 is connected via the upper two inputs of the SMARTsense device, and relay 2 via the lower two.

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Procedure (2/8)

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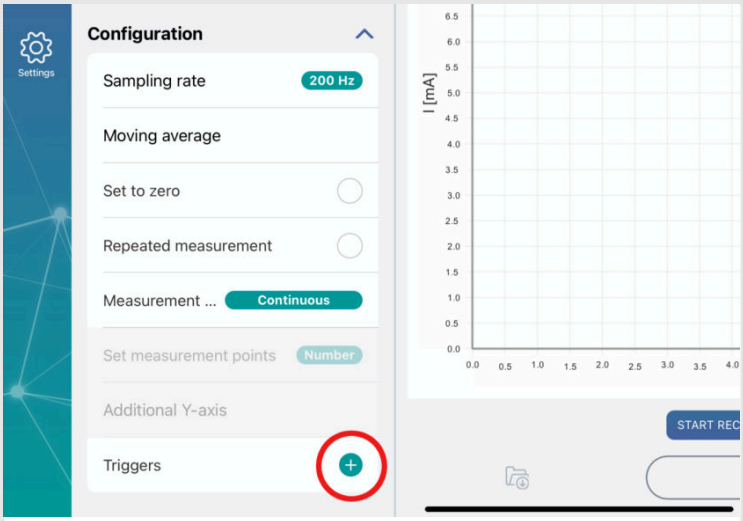

Adding a trigger

- Now programme the Cobra SMARTsense code.
- To do this, add a trigger for the SMARTsense code by pressing the plus button provided.
- If you set a trigger, this means that the Cobra SMARTsense code triggers a specific action as soon as a measured value fulfils a condition that you define.

Procedure (3/8)

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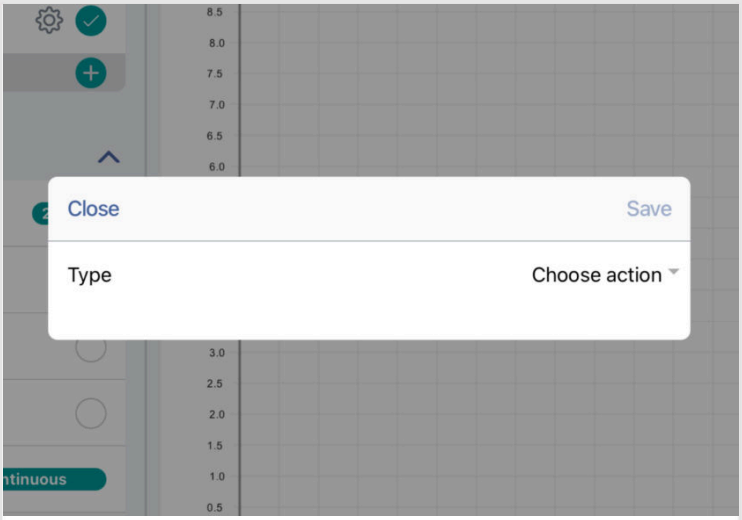

Adding an action

- A window will now appear in which you can select an action that you want to trigger. For our first trigger, we want the SMARTsense code to close relay 1 if the voltage is too high. Therefore, select the action "Code relay 1 off".
- By closing relay 1, the SMARTsense code protects the lamp from excessive voltage.

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Procedure (4/8)

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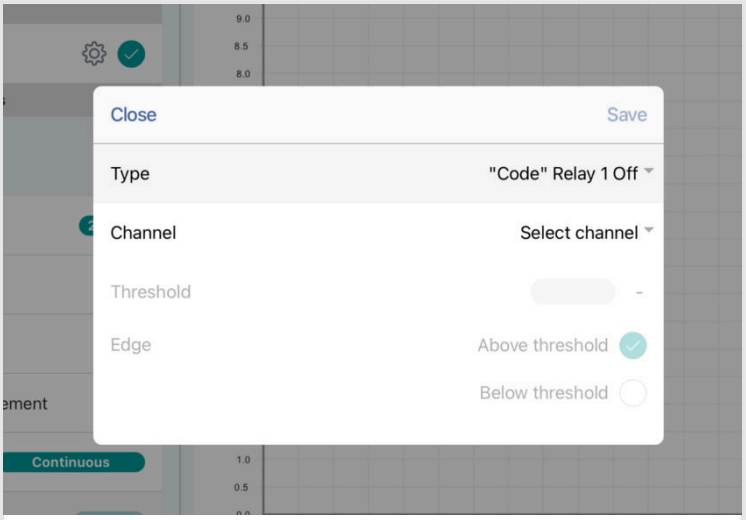

Setting a measurement channel

- Now you have to set which measurement should be taken into account. This will later be the measured channel that should fulfil a certain condition. In our case, this is the voltage. Therefore, select the corresponding measurement channel.

Procedure (5/8)

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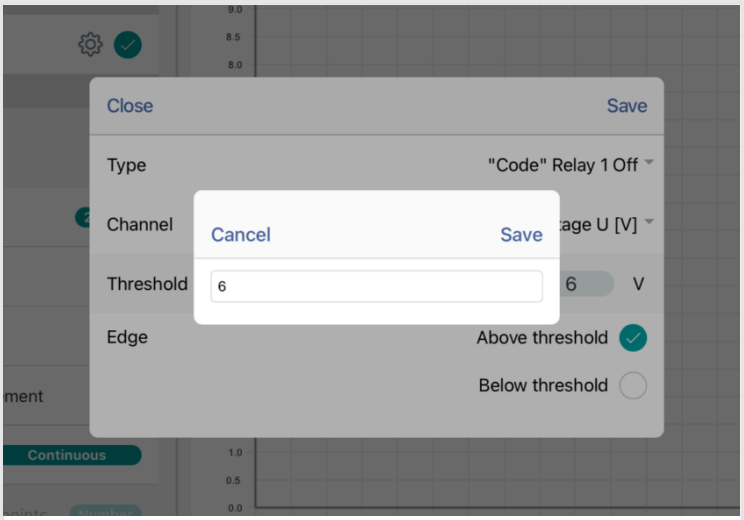

Setting a threshold value

- There are two options for when the action is triggered: Either it is triggered as soon as the threshold value is exceeded or when it falls below it. You select which of the two cases applies to this trigger in the next step. Now you must first define exactly how high the threshold value is by clicking on the corresponding text field.
- We want the current to be taken from the lamp when a voltage of $6\ \mathrm{V}$ is exceeded. Therefore choose $6\ \mathrm{V}$ as the threshold value.

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Procedure (6/8)

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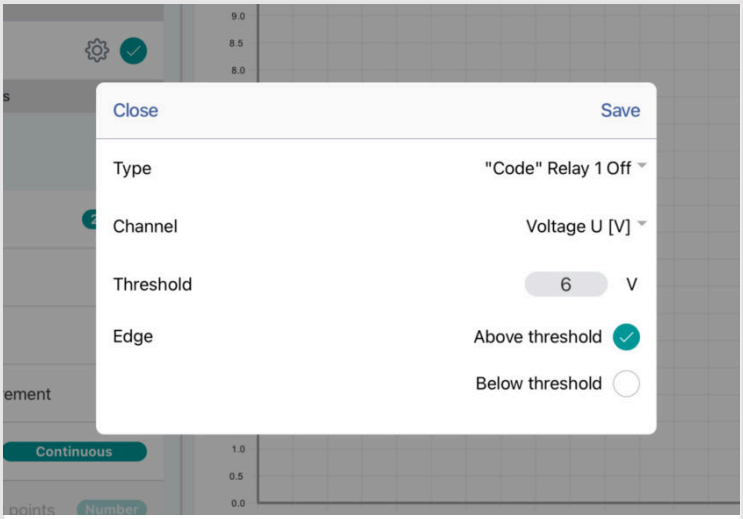
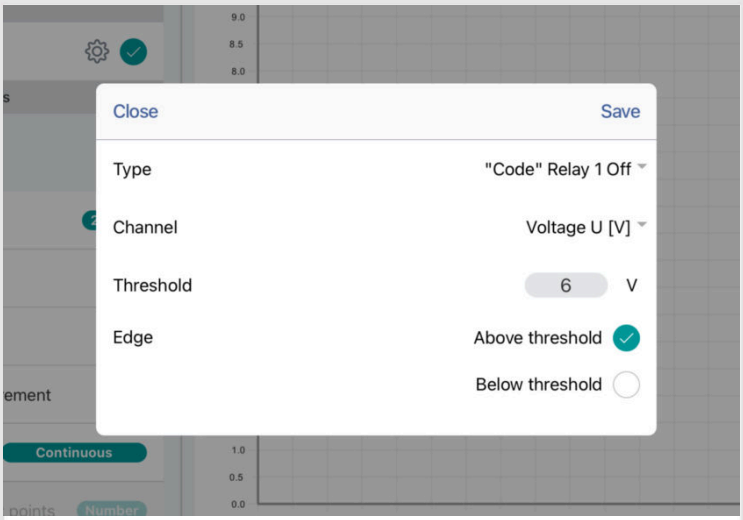


The finished settings

- Now you can select whether the action should be executed when the threshold value is exceeded or fallen below. First create a trigger that is triggered when the threshold value is exceeded. The finished settings are shown on the left.

Procedure (7/8)

PHYWE



The finished settings

- But now you need three more triggers. Add the following triggers independently:

1. Relay 1 should be switched on if $U < 6\ \mathrm{V}$
2. Relay 2 should be switched on if $U > 6\ \mathrm{V}$
3. Relay 2 should be switched off if $U < 6\ \mathrm{V}$

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Procedure (8/8)

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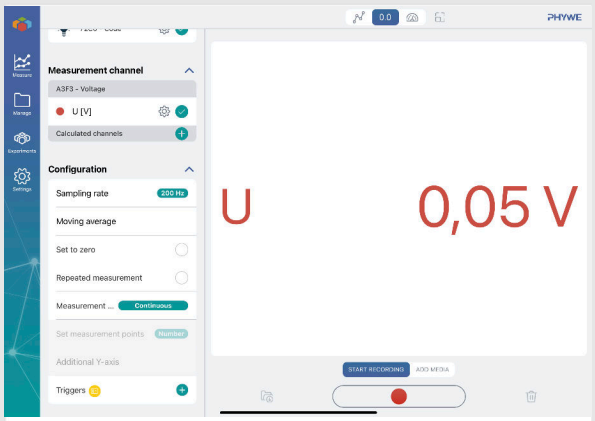

Fig. 8 Starting the measurement

- Display the voltage as a digital value by pressing "0.0" at the top of the display. Now start a measurement. Turn on the power supply unit with a voltage of $0\ \mathrm{V}$ and a current of $1\ \mathrm{A}$. Slowly increase the voltage and observe the light bulb. It should go out at a voltage of $6\ \mathrm{V}$. Continue increasing the voltage up to $10\ \mathrm{V}$, then gradually decrease it again.
- If your setup has worked correctly, you can now experiment with the Cobra SMARTsense code device. Do not change the conditions for when the relays are opened. However, you can configure additional responses, such as displaying a smiley or flashing an LED when a specific threshold value is reached.

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Report

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Task 1

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Briefly summarise what you have learned.

Each component has a maximum _____ that must not be exceeded. Since voltage _____ during complex current surges, automatic protection mechanisms are required to safeguard the components. In this experiment, an overvoltage protection system for a _____ was constructed using two _____. The relays were configured to disconnect the light bulb from the power supply as soon as the voltage became too high. To achieve this, the voltage was measured in _____ with both circuits.

Not used (alphabetically): _____, _____, _____

- can fluctuate
- light bulb
- is constant
- relays
- in series
- parallel
- voltage
- a resistor

Slide	Score / Total
Slide 24: Overvoltage protection of a light bulb	0/8

Total amount 0 / 8

Solutions Repeat

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