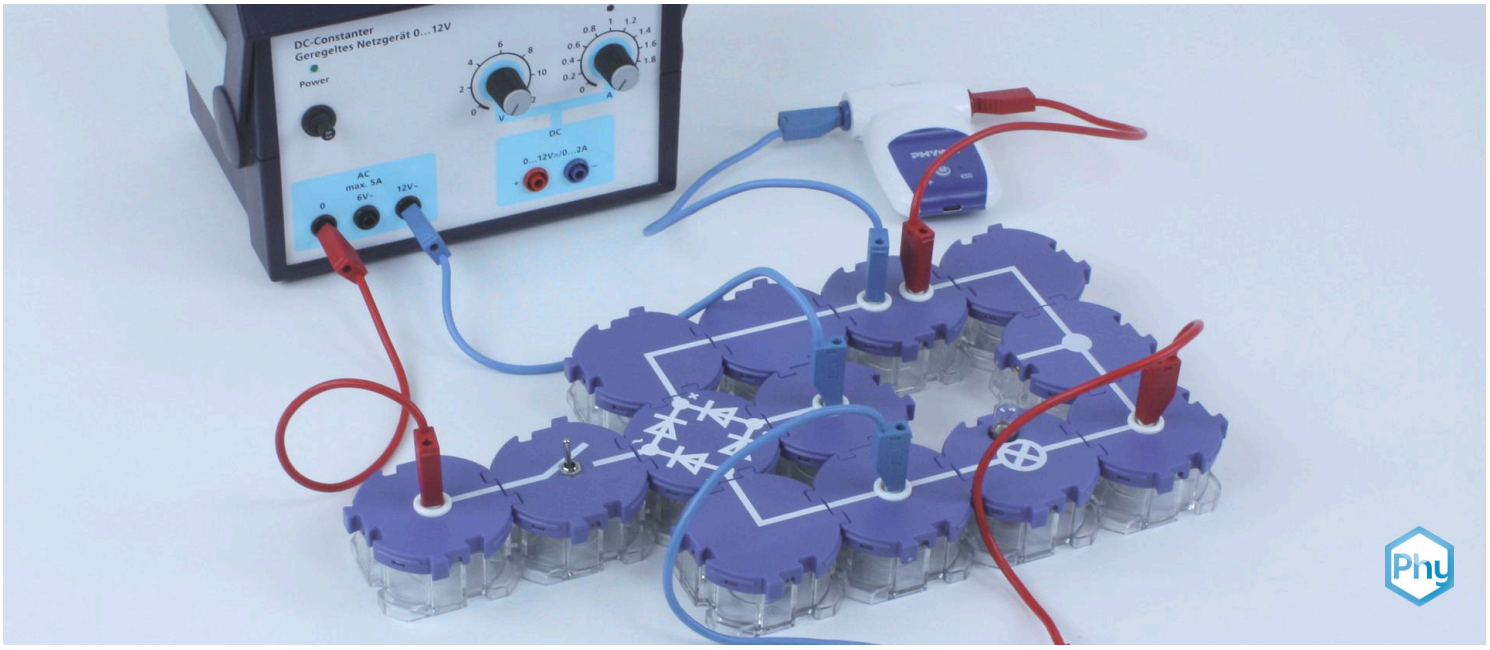
The bridge rectifier with Cobra SMARTsense



Physics > Electricity & Magnetism > Simple circuits, resistors & capacitors

Difficulty level	Group size	Preparation time	Execution time
easy	-	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/639c232126fa860003710237

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Teacher information

Application

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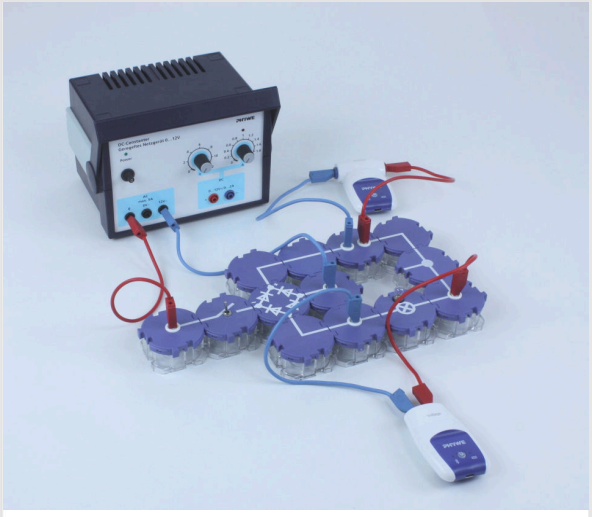

Experimental setup

A bridge rectifier is an efficient type of rectifier for converting AC to DC voltage. It is used in many power supplies where the AC voltage from the wall socket can be converted to DC voltage.

Ordinary rectifier circuits with individual diodes can only use one half-wave at a time with alternating current. The bridge rectifier avoids this problem by connecting four diodes in such a way that one current path is open for each half-wave.

In this experiment, the functioning of a bridge rectifier is investigated.

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Other teacher information (1/3)

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Prior knowledge

The students should be able to construct and understand a simple current circuit. They should also already have a basic understanding of half-waves and pulsating direct current. Ideally, students are already familiar with the operation of a single diode.

Principle

In a bridge rectifier, four diodes are connected so that the polarity of the output voltage is independent of the polarity of the input voltage. This allows an alternating voltage to be rectified.

Other teacher information (2/3)

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Learning objective

After the students have learned about the rectifying effect of a diode, this experiment is intended to help them understand how the bridge circuit, which is primarily used in practice, works. They should understand that by using a bridge circuit, the current flows through the working resistor in the same direction during each half-cycle of the alternating current.

Tasks

First, the effect of the polarity of DC voltage on the bridge rectifier is investigated and it is found that it makes no difference.

Then switch to AC voltage and observe that the current still flows through the circuit in the same direction.

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Other teacher information (3/3)

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Notes on set-up and procedure

Do not connect the bridge rectifier to the power supply at the wrong terminals because it will short-circuit the power supply. Prolonged use with short-circuit current could burn out the diodes. When connecting to the DC output, the current can and should be limited with the current limiting controller, but at the AC output the full 5 A would flow and destroy the diodes in the long run.

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

Motivation

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Power supply unit - application example of a rectifier

A bridge rectifier is an efficient type of rectifier for converting AC to DC voltage. It is used in many power supplies where the AC voltage from the wall socket is to be converted into DC voltage.

In this experiment you will learn how the bridge rectifier converts the respective half-periods of the alternating current into a direct current.

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Tasks

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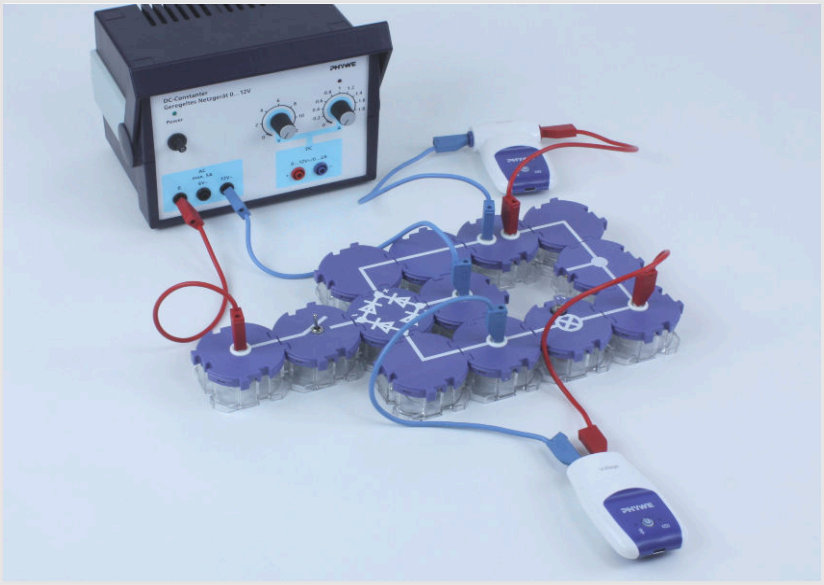
How can both half-cycles of alternating current be used to generate direct current?

Investigate the mode of operation of a bridge rectifier by trying out different polarities for direct and alternating current.



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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
2	Cobra SMARTsense - Voltage, ± 30 V (Bluetooth)	12901-00	1
3	Cobra SMARTsense - Current, ± 1 A (Bluetooth)	12902-00	1
4	Junction module, SB	05601-10	2
5	Bridge rectifier module, SB	05655-00	1
6	On-off switch module, SB	05602-01	1
7	Angled connector module, SB	05601-02	3
8	Straight connector module, SB	05601-01	2
9	Straight connector module with socket, SB	05601-11	1
10	Interrupted connector module with sockets, SB	05601-04	1
11	Angled connector module with socket, SB	05601-12	1
12	Socket module for incandescent lamp E10, SB	05604-00	1
13	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
14	Connecting cord, 32 A, 250 mm, red	07360-01	2
15	Connecting cord, 32 A, 250 mm, blue	07360-04	2
16	Connecting cord, 32 A, 500 mm, red	07361-01	1
17	Connecting cord, 32 A, 500 mm, blue	07361-04	1
18	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up (1/2)

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For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the relevant app store (see below for QR codes). Before starting the app, please check that on your device (smartphone, tablet, desktop PC) **Bluetooth** is **activated**.

iOS

Android

Windows

Set-up (2/2)

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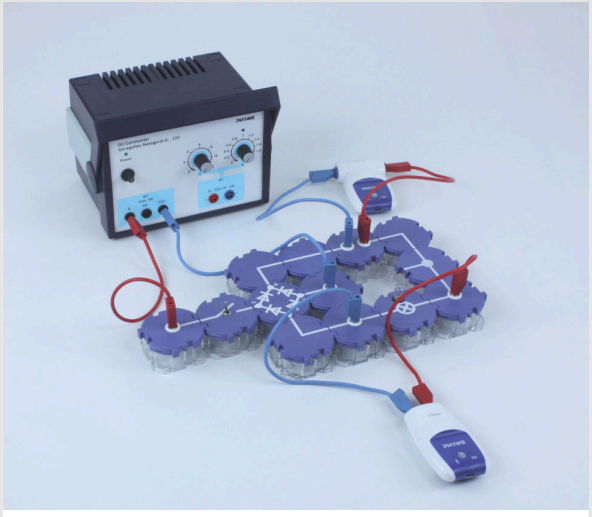

Experimental setup

Set up the experiment according to the FIgure and circuit diagram part a), connect the circuit to the DC output of the power supply unit.

Attention: Connect the bridge rectifier to the power supply unit only with the ~ inputs, never with the +/- inputs!

Circuit diagram a)

Circuit diagram b)

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Procedure (1/3)

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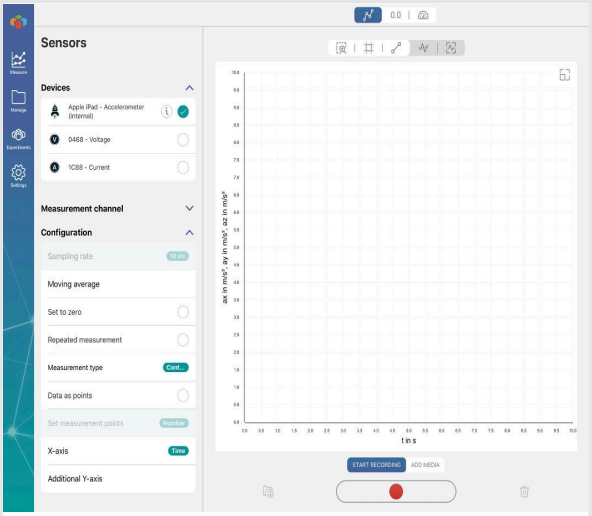

PHYWE MeasureApp

- Turn on both SMARTsense sensors by pressing and holding the power button and make sure the tablet can connect to Bluetooth devices.
- Open the PHYWE measure app and connect the sensors under "Measure" > "Sensor" and then select the sensor "Current" and "Voltage" (top left).
- Select the sampling rate of your choice. The higher it is, the more accurate the measurement will be.
- After each of the following measurements, the measurement can be saved. For further analysis, the measurement can be opened again at any time under "My measurements".

Procedure (2/3)

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Direct current

- Switch the power supply unit to $12\,V$ and $0,4\,A$ and switch on.
- Observe the current and voltage values displayed in measureAPP, respectively, for all subsequent changes to the circuit.
  - Close the switch.
  - Swap the leads on the power supply unit and thereby change the polarity of the circuit.
  - Turn the bridge rectifier 180°.
  - Swap the wires on the power supply again and change the polarity of the circuit.

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Procedure (3/3)

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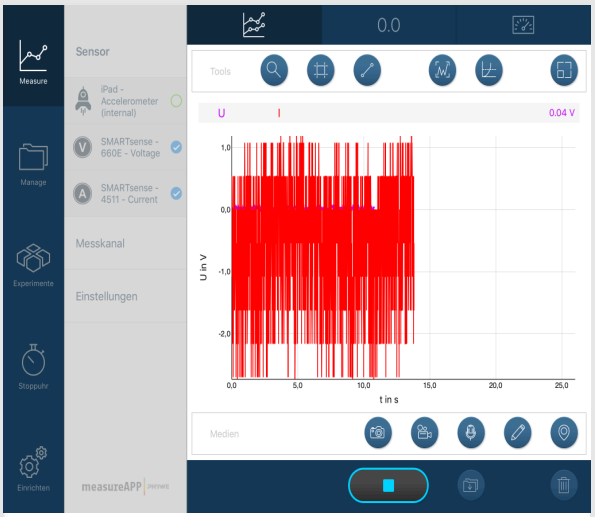
Alternating current

- Connect the circuit to the AC output $12\ V$~ of the power supply unit.
- Start a measurement in measureAPP and stop the measurement when data becomes visible in the diagram as shown in the figure. Save measured values for further analysis and open them again under "Measurements".
- Use the zoom function to display the initial section of the measurement data up to approx. 0.1 s (corresponding to five periods of 50 Hz alternating current).
- Turn the bridge rectifier 180° and repeat the measurement.



Measuring window

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Report

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Task 1

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What follows from the observations on direct current?

The polarity has an influence on the flow direction in the consumer circuit and is not influenced by the bridge rectifier, so that the rotation of the bridge rectifier has no influence on the measurement result.

Both reversing the polarity and turning the bridge rectifier rotates the direction of current flow through the load circuit.

The bridge rectifier allows the current to flow through the consumer circuit in one direction only, regardless of the polarity. If the rectifier is reversed, the current flows in the other direction regardless of the polarity.

Task 2

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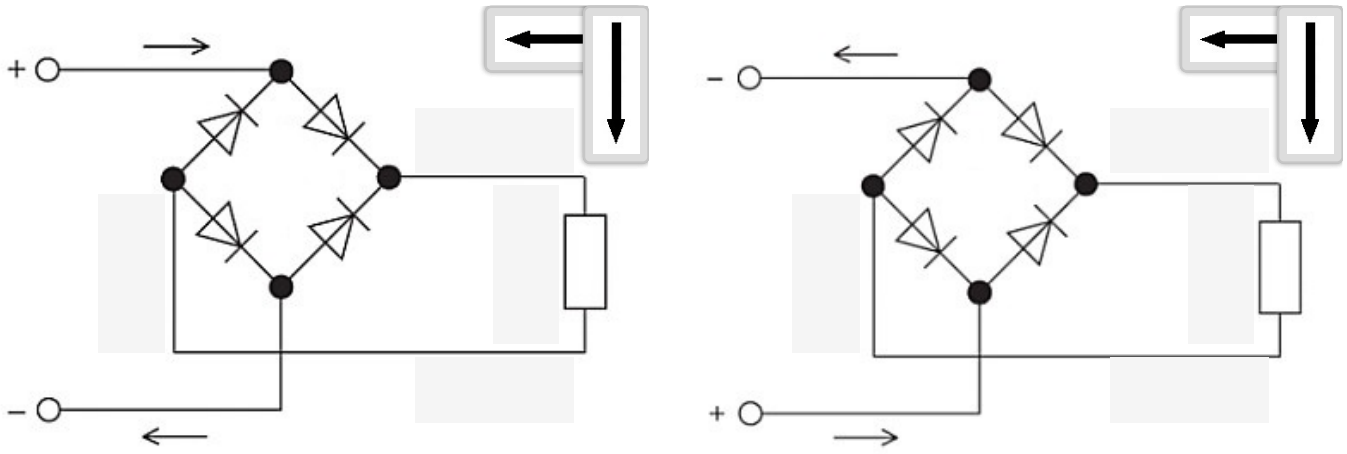
Use arrows to mark the current paths in the bridge rectifier for both poles of the voltage.



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Task 3

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What can be seen from the measurements at AC voltage?

- [ ] The AC voltage is only amplified by the bridge rectifier.
- [ ] Both the voltage and the current correspond to repeating half-waves.
- [ ] The rotation of the bridge rectifier changes the sign of the voltage and current at the consumer.
- [ ] The sine-shaped alternating current becomes a magnitude function of the sine through the bridge rectifier.

Check

Task 4

PHYWE

What is the advantage of a bridge rectifier compared to a simple diode? Drag the words into the correct boxes!

With a bridge rectifier, the current flow is _____ in the same direction _____ of the polarity. With a simple diode, the current flow is _____ in one direction and thus only half of the voltage signal is transmitted. In an I-t diagram, you can think of it like this: With _____, the lower half-wave in each case is folded upwards. With _____, however, this is simply set to zero.

bridge rectifiers
diodes
directed
independently
blocked

Check

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Slide	Score / Total
Slide 17: Explanation Observation Direct current	0/1
Slide 18: Multiple tasks	0/8
Slide 19: Explanation Observation Alternating current	0/3
Slide 20: Difference between bridge rectifier and diode	0/5

Total 0 / 17

Solutions Repeat

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