Capacitors in alternating current circuits (Item No.: P1382200)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 14-16
Topic: Electricity
Subtopic: Properties of electrical components
Experiment: Capacitors in alternating current circuits

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

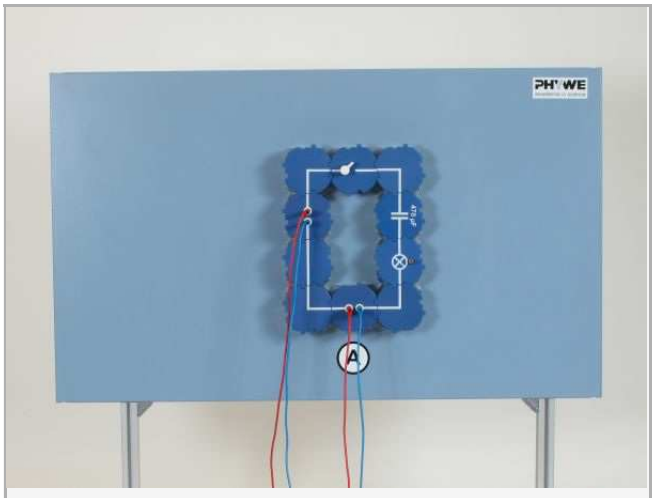
Experiment Variations:

Keywords:

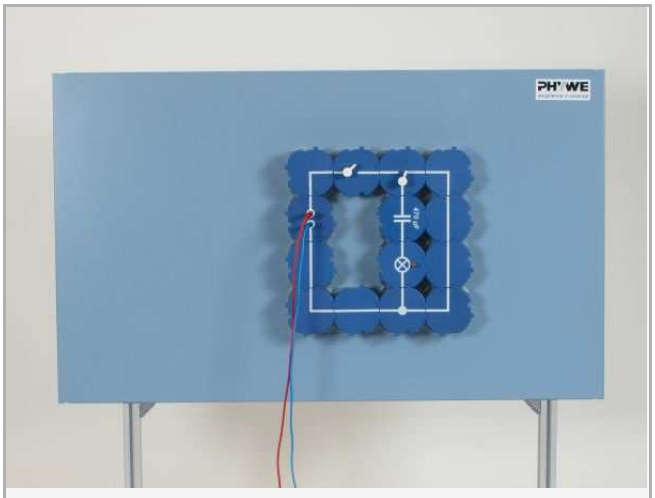
Principle and equipment

Principle

It is to be demonstrated, that a capacitor does not interrupt an alternating current circuit.



Experimental set-up Part 1



Experimental set-up Part 2

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	1
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Switch on/off, module DB	09402-01	1
5	Switch, change-over, module DB	09402-02	1
6	Socket for incandescent lamp E10 ,module DB	09404-00	1
7	Connector interrupted, module DB	09401-04	2
8	Capacitor(ELKO)0.047 mF,module DB	09445-47	1
9	Capacitor(ELKO),0.1 mF,module DB	09446-10	1
10	Capacitor(ELKO),0.47 mF,module DB	09446-47	1
11	Electr.symbols f.demo-board,12pcs	02154-03	1
12	Connector, straight, module DB	09401-01	4
13	Connector, angled, module DB	09401-02	4
14	Connector, T-shaped, module DB	09401-03	1
15	Filament lamp 6 V/3 W, E10, 10 pcs.	35673-03	1
16	Filament lamps 4V/0.04A, E10, 10	06154-03	1
17	Connecting cord, 32 A, 1000 mm, blue	07363-04	2
18	Connecting cord, 32 A, 1000 mm, red	07363-01	2

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Set-up and procedure

1st. Experiment

- Connect up the circuit as shown in Fig. 1 with the 470 µF capacitor inserted and the on/off switch open
- Set ADM 2 to measurement range 1 A~ and switch it on.
- Set the power supply to 6 V~, close the circuit, observe the lamp, measure the current, enter the measured value and what you observe in Table 1.
- Break the circuit, replace the 470 µF capacitor with the 100 µF capacitor.
- Close the circuit, observe the lamp, measure the current, note the measured value and what you observe.
- Replace the 100 µF capacitor with the 47 µF capacitor, repeat the above procedure.
- Replace the capacitor with a straight connector module and proceed as above.

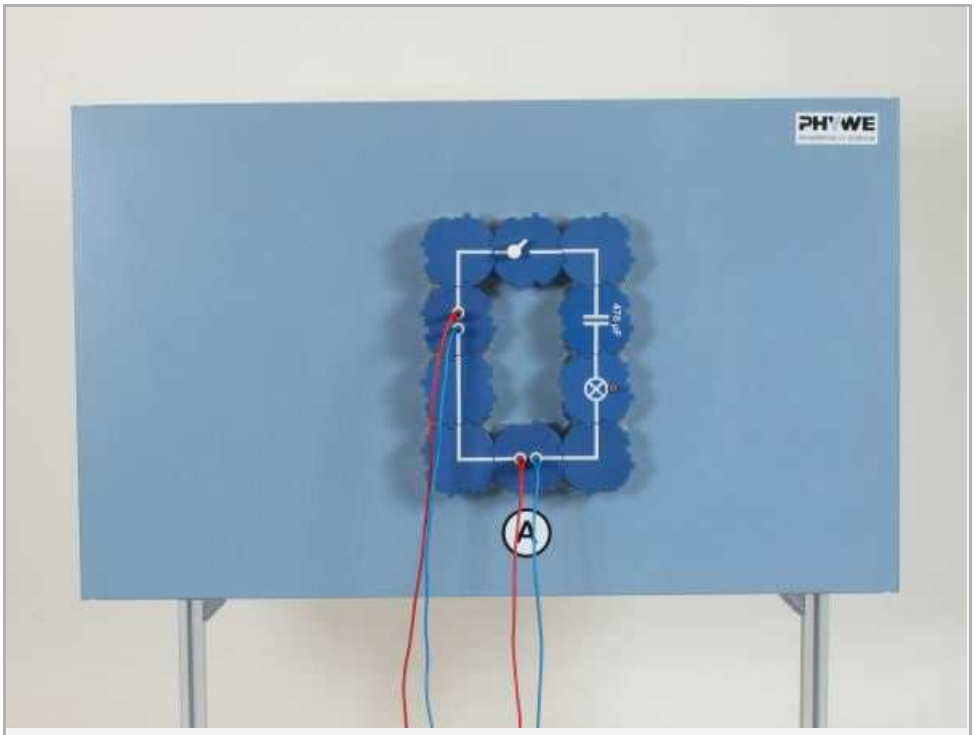

Fig. 1

2nd. Experiment

- Break the circuit, again replace the 47 µF capacitor with the 470 µF capacitor, replace the 6 V lamp with the 4 V lamp, set the measuring instrument to the 100 mA- measurement range (see Fig. 2).
- Set the power supply to 10 V direct voltage.
- Close the circuit and operate the changeover switch several times, observe the lamp and the measuring instrument (1).

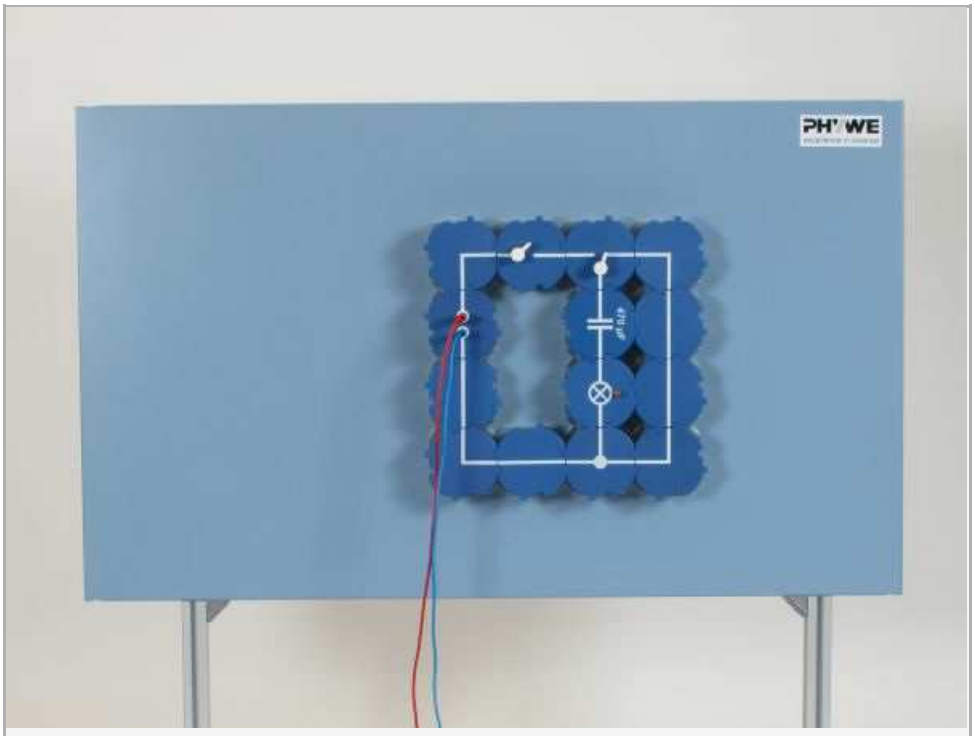

Fig. 2

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Observation and evaluation

Observation

Table 1

$\frac{C}{\mu F}$	Lamps light up	$\frac{I}{mA}$
470	brightly	450
100	very weakly	200
47	not at all	100
None	brightly	500

1. A brief current impulse, that charges or discharges the capacitor, is only given when the circuit is closed and on short-circuiting the capacitor.

Evaluation

A capacitor in an alternating current circuit has a finite resistance. An alternating current flows, the strength of which is dependent on the capacity of the capacitor. The larger the capacity, the stronger the current and the less the resistance with which the capacitor opposes the flow of alternating current.

A capacitor in a direct current circuit has a very high resistance. There is therefore hardly a measurable flow of current.

Remarks

The alternating current resistance of a capacitor is called its capacitive resistance X_C. It is a pure reactance, as the electrical energy is not transformed into any other form of energy. The alternating current resistance of a capacitor is given by: $X_C = 1/(2 \cdot \pi \cdot f \cdot C)$.

whereby $f = 50\ \mathrm{Hz}$, the frequency of the alternating current.
The capacitors have the following alternating current resistances:

$C = 470\ \mu\mathrm{F}\ X_C = 6.8\ \Omega$

$C = 100\ \mu\mathrm{F}\ X_C = 31.8\ \Omega$

$C = 47\ \mu\mathrm{F}\ X_C = 67.7\ \Omega$

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