

Capacitors in direct current circuits (Item No.: P1373400)

Curricular Relevance



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

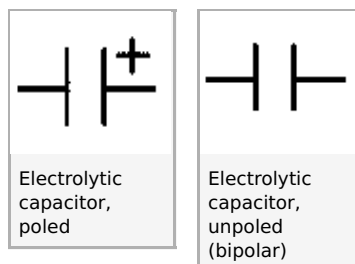
The students generally have some knowledge on what a capacitor is, and from this, and in association with the symbol, probably think of them as a pair of plates. Even though the capacitors used in this experiment do not correspond to this picture they have, they will still not expect a current to flow when a capacitor is connected in a direct current circuit. The result of the experiment will therefore surprise them and awake even more of their interest!

Notes on setup and procedure

In the last part of the experiment, the charging and discharging currents must be measured with an ammeter, because the filament lamp does not visibly react to the very small surges of current. Make absolutely sure that the 30 mA measurement range is set and under no circumstances a smaller one, because a deflection to the left can also go out of the scale; and that should be kept small, as the case here is. The deflection of the pointer would be larger in the 3 mA measurement range, but the zero point of the measuring instrument would have to be previously changed by means of the adjusting screw.

Remarks

Since the recommended capacitor is unpoled, or bipolar (both terms are commonly used), the students do not have to pay attention to correct polarity. The graphical symbols used in wiring diagrams designate the type of capacitor:



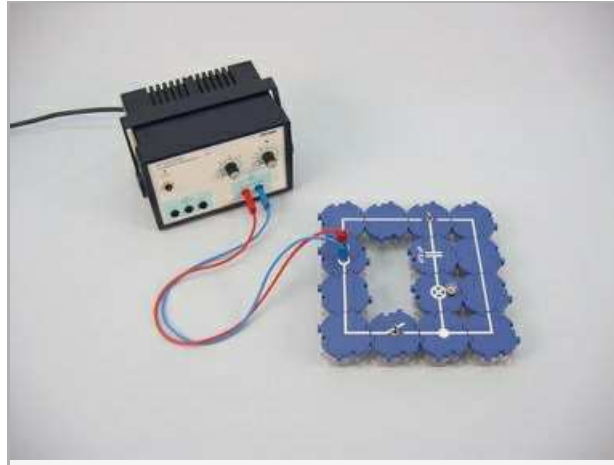
Capacitors in direct current circuits (Item No.: P1373400)

Task and equipment

Task

How does a capacitor act in a direct current circuit?

Investigate the effect of fitting a capacitor into a direct current circuit. Pay particular attention to what happens when switching on and switching off.



Equipment

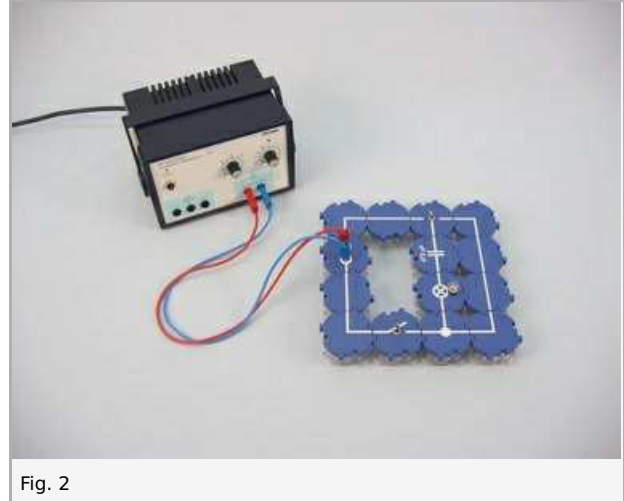
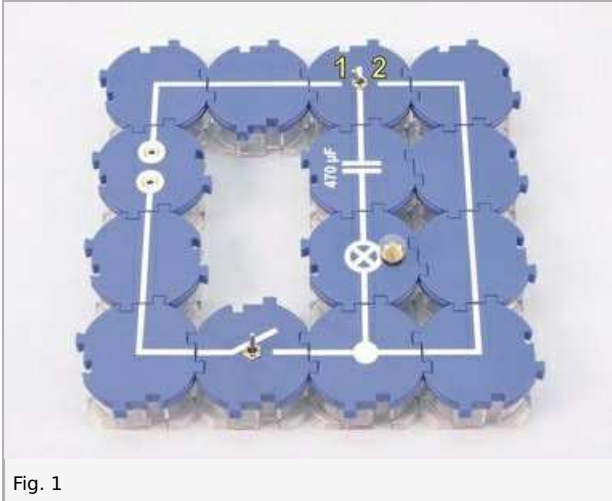


Position No.	Material	Order No.	Quantity
1	Straight connector module, SB	05601-01	4
2	Angled connector module, SB	05601-02	4
3	T-shaped connector module, SB	05601-03	1
4	Interrupted connector module, SB	05601-04	2
5	On-off switch module, SB	05602-01	1
6	Change-over switch module, SB	05602-02	1
7	Socket module for incandescent lamp E10, SB	05604-00	1
8	Capacitor module 47 μ F non-polar electrolytic, SB	05645-47	1
9	Capacitor module 470 μ F non-polar electrolytic, SB	05646-47	1
10	Connecting cord, 32 A, 500 mm, red	07361-01	1
11	Connecting cord, 32 A, 500 mm, blue	07361-04	1
12	Connecting cord, 32 A, 250 mm, red	07360-01	1
13	Connecting cord, 32 A, 250 mm, blue	07360-04	1
14	Filament lamps 4V/0.04A, E10, 10	06154-03	1 piece
15	Multi-range meter, analogue	07028-01	1
16	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

Set-up and procedure

Set-up

Set up the circuit as shown in Fig. 1 and Fig. 2, using the 470 μF capacitor initially. Turn the on/off switch to the off position and the changeover switch to position 1.



Procedure

- Switch on the power supply and set 12 V direct voltage.
- Close the on/off switch and observe the lamp.
- Turn the on/off switch off and on observing the lamp; note your observations under Result - Observations 1 in the report.

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- With the on/off switch closed, turn the changeover switch to position 2 and observe the lamp.
 - Repeatedly operate the changeover switch and note what you observe under Result - Observations 2.

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- Return the changeover switch to position 1, then open the on/off switch to break the circuit.
 - After 1 or 2 seconds, turn the changeover switch to position 2, observe the lamp and note what you observe under Result - Observations 3.

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- Replace the 470 μF capacitor which is in the circuit with the 47 μF capacitor, as shown in Fig. 3 and Fig. 4. Close the circuit with the on/off switch and repeatedly operate the changeover switch; observe the lamp and note what you observe under Result - Observations 4.

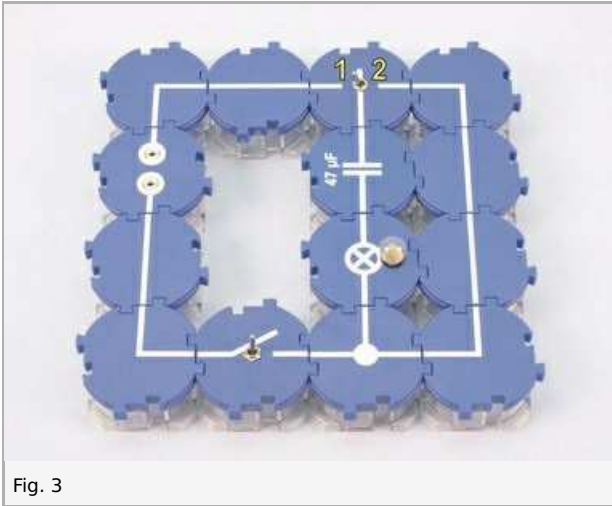


Fig. 3

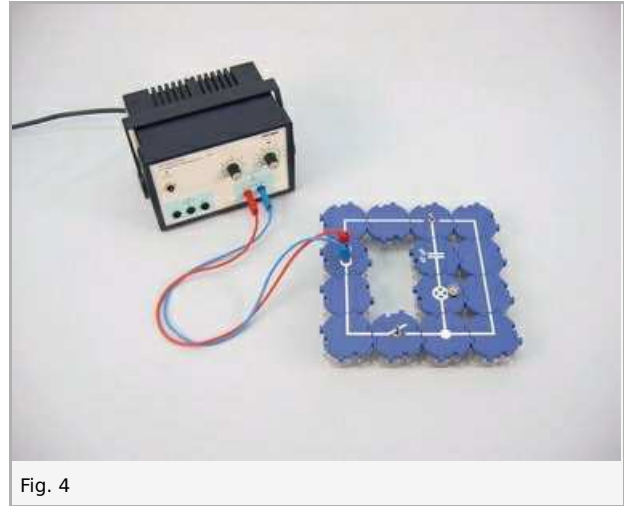


Fig. 4

- Set the multi range meter to measurement range 30 mA– and install it in the circuit as an ammeter in place of the filament lamp, as shown in Fig. 5 and Fig. 6.
- Repeatedly operate the changeover switch; observe the ammeter and note what you observe under Result - Observations 5.

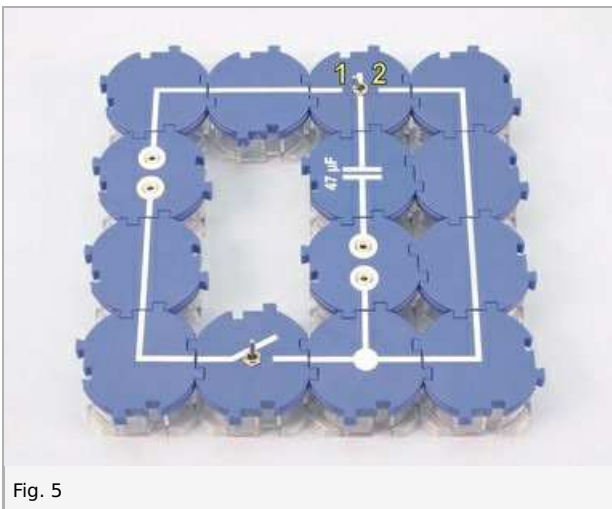


Fig. 5

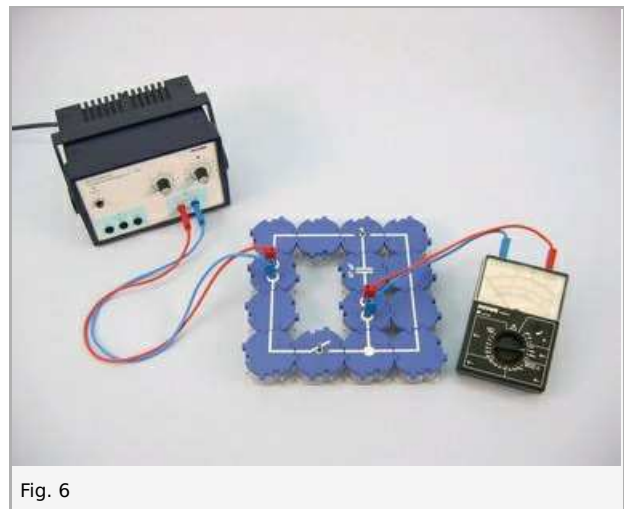


Fig. 6

- Switch off the power supply.

Report: Capacitors in direct current circuits

Result - Observations 1

Note your observations.

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Result - Observations 2

Note your observations.

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Result - Observations 3

Note your observations.

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Result - Observations 4

Note your observations.

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Result - Observations 5

Note your observations.

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Evaluation - Question 1

Which conclusions can you draw from Observations 1 and 2?

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Evaluation - Question 2

Which conclusions can you draw from Observations 3?

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Evaluation - Question 3

What follows from Observations 4 and 5?

Note: The capacity (C) of a capacitor for an electric charge is measured in Farad units (F). One microfarad ($1 \mu\text{F}$) is a millionth of a Farad; $C = Q / U$; $1 \text{ F} = 1 \text{ A} \cdot \text{s/V}$.

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Evaluation - Question 4

Look closely at the capacitors used in this experiment and describe them.

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