Current transformation (DEMO)

Physics > Electricity & Magnetism > Electromagnetism & Induction

Physics > Electricity & Magnetism > Use of electrical energy, energy supply

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

This content can also be found online at:

http://localhost:1337/c/6478fa50e6e35e00020403a7

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Teacher information

Application

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Experimental setup

Transformers are needed to transform input currents higher, lower or equal. Current transformers are usually built into the power supply unit of many electrical devices. In this experiment, the dependence of the number of turns and the current strength is investigated.

If a transformer is heavily loaded on the secondary side, the current strength in the secondary circuit depends on the primary current strength and the number of turns of the coils.

To investigate the regularity, different transformers are examined, first keeping the number of turns and current constant on the primary side and then on the secondary side.

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Other teacher information (1/2)

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Prior knowledge

No prior knowledge is required.

Principle

When alternating current flows through a coil, it creates a varying magnetic field, which in turn can induce a current in another coil.

In contrast to the voltages, the currents in a transformer are inversely proportional to the windings. Furthermore, if the primary current flows in a counterclockwise direction through the coil, the current in the secondary coil flows in exactly the opposite direction. By applying the flow theorem, the following applies:

$$I_1 \cdot n_1 = I_2 \cdot n_2$$

Other teacher information (2/2)

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Learning objective

Students should understand how alternating currents can be converted into lower and higher currents.

Tasks

Investigate the relationship between the number of turns and the currents.

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Student information

Motivation

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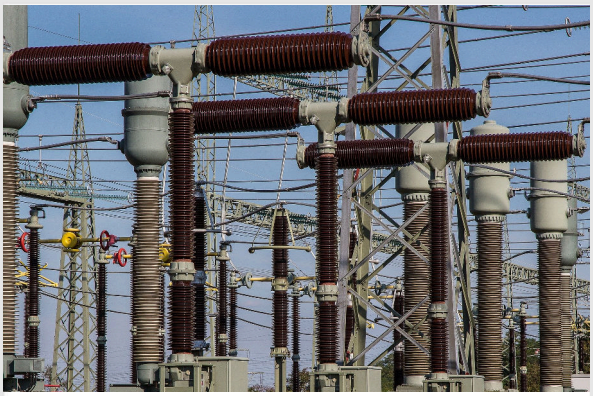
Transformers are built into many electrical devices. In order to transform current well, the coils must not be too far apart and an iron core is important.

This experiment investigates the relationship between current strength and number of turns.



Transformer station

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Variable transformer with digital display DC: 0...20 V, 12 A / AC: 0...25 V, 12 A	13542-93	1
2	PHYWE Demo Multimeter ADM 3: current, voltage, resistance, temperature	13840-00	2
3	Iron core, U-shaped, laminated	06501-00	1
4	Iron core, I-shaped, laminated	06500-00	1
5	Pins for iron cores, U-shaped	06502-00	1
6	Clamping device for iron cores	06506-00	1
7	Coil, 300 turns	06513-01	2
8	Coil, 600 turns	06514-01	1
9	Coil, 1200 turns	06515-01	1
10	Connecting cord, 32 A, 750 mm, black	07362-05	3
11	Connecting cord, 32 A, 750 mm, blue	07362-04	2

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Set-up

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Set up the experiment according to Fig. 1.

- Place two coils with 300 turns on the U-core.
- Insert the iron pins into the legs of the U-core and put on the yoke.
- Press the transformer firmly together using the clamping device.
- Connect the primary coil to the AC output of the regulating transformer via a measuring device. Select the measuring range 1 A~.
- Connect the secondary coil to the second meter. Select the measuring range 1 A~.

Fig. 1

Procedure (1/2)

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Experiment 1

- Adjust the voltage at the regulating transformer so that the primary current is $I_1 = 1A$.
- Read the secondary current strength I_2 and enter it in Table 1 in the report.
- Change the transformer, insert the secondary coil with 600 turns and repeat the measurement. Choose a suitable measuring range.
- Select the secondary coil with 1200 turns and repeat measurement.

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Procedure (2/2)

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Experiment 2

- Build the transformer with primary coil and secondary coil of 300 turns each.
- Adjust the voltage at the regulating transformer so that the secondary current strength is $I_2 = 500mA$.
- Read the primary current I_1 and enter it in Table 2.
- Change the transformer, insert the primary coil with 600 turns and repeat the measurement. Choose a suitable measuring range.
- Select the primary coil with 1200 turns and repeat the measurement.

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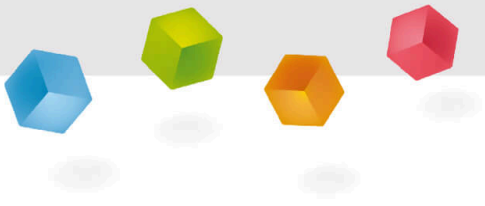

Report

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Task (1/5)

Table 1: $n_1 = 300;\ I_1 = 1\,\mathrm{A}$

n_2	I_2 [mA]	n_1/n_2	I_1/I_2
300			
600			
1200			

Task (2/5)

Table 2: $n_2 = 300;\ I_2 = 500\,\mathrm{mA}$

n_1	I_1 [mA]	n_1/n_2	I_1/I_2
300			
600			
1200			

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Task (3/5)

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Drag the words into the correct boxes!

A _____ number of turns of the primary coil n_1 and a constant primary current I_1 causes an _____ in the number of turns n_2 of the secondary coil and a _____ of the secondary current intensity I_2.

constant
increase
reduction

Check

Task (4/5)

PHYWE

Drag the words into the correct boxes!

Table 1 shows that _____ is roughly halved when the number of turns doubles. With a constant number of turns in the _____ n_2, a higher number of turns in the _____ n_1 requires a lower _____ I_1 in order to achieve a desired constant _____ I_2.

primary current
primary coil
current
secondary coil
secondary current

Check

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Task (5/5)

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Drag the words into the correct boxes!

Table 2 shows that if the _____ n_1 is doubled, the _____ I_1 only has to be about half as large in order to keep the _____ constant.

The following relationship exists between the current strengths and the number of turns on a transformer heavily loaded on the secondary side:

The _____ in the primary and secondary circuits are inversely related to each other like the number of turns.

current strengths

primary current

number of turns

secondary current

Check

Slide	Score / Total
Slide 14: Transformer summary	0/3
Slide 15: Constant primary current	0/5
Slide 16: Constant secondary current	0/4

Total score 0 / 12

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