Current transformation (Demo) (Item No.: P1434205)

Curricular Relevance

Area of Expertise:	Education Level:	Topic:	Subtopic:	Experiment:
Physics	Age 16-19	Electricity	Electromagnetism	Current transformation

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	20 Minutes	1 Student

Additional Requirements:

- 2 Demonstrations multimeter
- Power Supply

Experiment Variations:

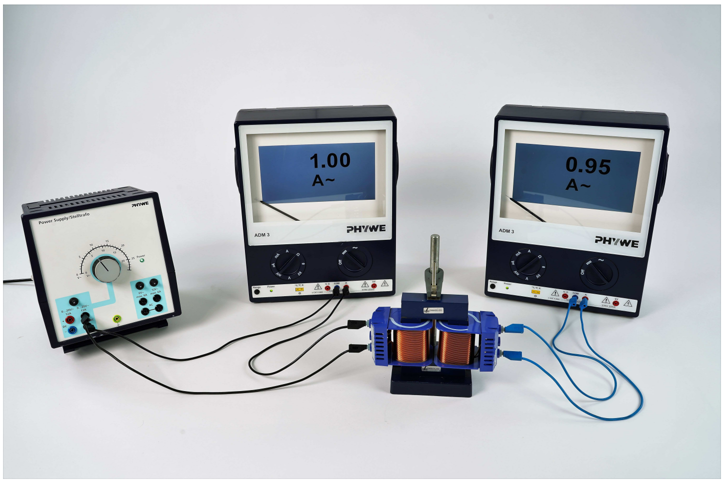
Keywords:

Trafo, Current trafo, Transformator

Information for teachers

Introduction

If the load of the secondary side of a transformer is high, the current in the secondary circuit depends on the primary circuit current and the number of windings of the coils. For investigation of the relations, different transformers will be examined. First, the number of windings and the current on the primary side will be kept constant, afterwards they will be kept constant on the secondary side.



Equipment

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

Safety information

For this experiment, the general instructions for safe experimentation in scientific teaching apply.

Introduction

Application and Task

Transformers are needed to transform an input current larger, smaller or equal. Current transformers are usually installed in the power supply in many electrical devices. In this experiment, the dependence on the number of turns and current is examined.

Theory

In contrast to the voltages in a transformer, the currents are inversely proportional to the windings. Furthermore, when the primary current flows left through the coil, the current in the secondary coil flows exactly the other way around. By applying the flow rate, the following applies:

$$I_P \cdot N_P = I_S \cdot N_S$$

Setup and Procedure

Setup

Fig. 1

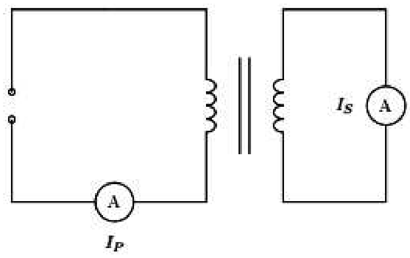


Fig. 2

Set-up the experiment as shown in Fig. 1 and Fig.2:

- Put two coils with each 300 windings on the U-core.
- Stick the iron core pins into the legs of the U-core and place the yoke on top.
- Compress the transformer tightly using the clamping device.
- Connect the primary coil to the alternating voltage output of the variable transformer via the measuring instrument. Select the digital display AC.
- Connect the secondary coil to the second measuring instrument. Select the digital display AC.

Procedure

Experiment 1

- Set the voltage at the variable transformer in such a way that the primary current $I_P = 1\,\mathrm{A}$.
- Read the secondary current I_S and note it down.
- Change the transformer: Select the coil with 600 windings as secondary coil and repeat the measurement.
- Select the coil with 1200 windings as secondary coil and repeat the measurement.

Experiment 2

- Set-up the transformer using primary and secondary coils with each 300 windings again.
- Set the voltage at the variable transformer in such a way that the secondary current $I_S = 0.5\,\mathrm{A}$.
- Read the primary current I_P and note it down.
- Change the transformer: Select the coil with 600 windings as primary coil and repeat the measurement.
- Select the coil with 1200 windings as primary coil and repeat the measurement.

Evaluation

Observation

Experiment 1

Table 1 shows the measurment results for a fixed primary coil with 300 windings and a primary current of 1 A.
The current of the secondary coil in dependence of the windings number is shown.
Note: The measured values may differ.

Table 1: $N_P = 300\,, I_P = 1\,A$

N_S	$\frac{I_S}{\mathrm{A}}$	$\frac{N_P}{N_S}$	$\frac{I_P}{I_S}$
300	0,99	1	1.01
600	0,49	0.5	2.02
1200	0,25	0.25	4

Experiment 2

Table 2 shows the measurement results for a fixed secondary coil with 300 windings and a secondary current of 0.5 A.
The current of the primary coil in dependence of the windings number is shown.
Note: The measured values may differ.

Table 2: $N_S = 300$, $I_S = 0.5\,A$

N_P	$\frac{I_P}{\mathrm{A}}$	$\frac{N_P}{N_S}$	$\frac{I_P}{I_S}$
300	0.5	1	1
600	0.24	2	0.48
1200	0.11	4	0.22

Result

For a constant windings number of the primary coil N_P and a constant primary current I_P, an increase of the secondary windings number N_S leads to a decrease of the secondary current I_S.

Table 1 shows that the current is approximately divided in half, when the windings number is doubled.

For constant windings number of the secondary coil N_S at a higher windings number of the primary coil N_P, a lower primary current I_P is required to reach the desired secondary current I_S.

Table 2 shows that for a doubled windings number N_P, the primary current I_P only needs to be half the value to keep the secondary current I_S constant.

Between currents and windings numbers, the following relation persists for a transformer loaded at the secondary side:
The currents in primary and secondary circuit behave inversely proportional to the windings numbers.

$$\frac{I_P}{I_S} = \frac{N_S}{N_P}$$

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