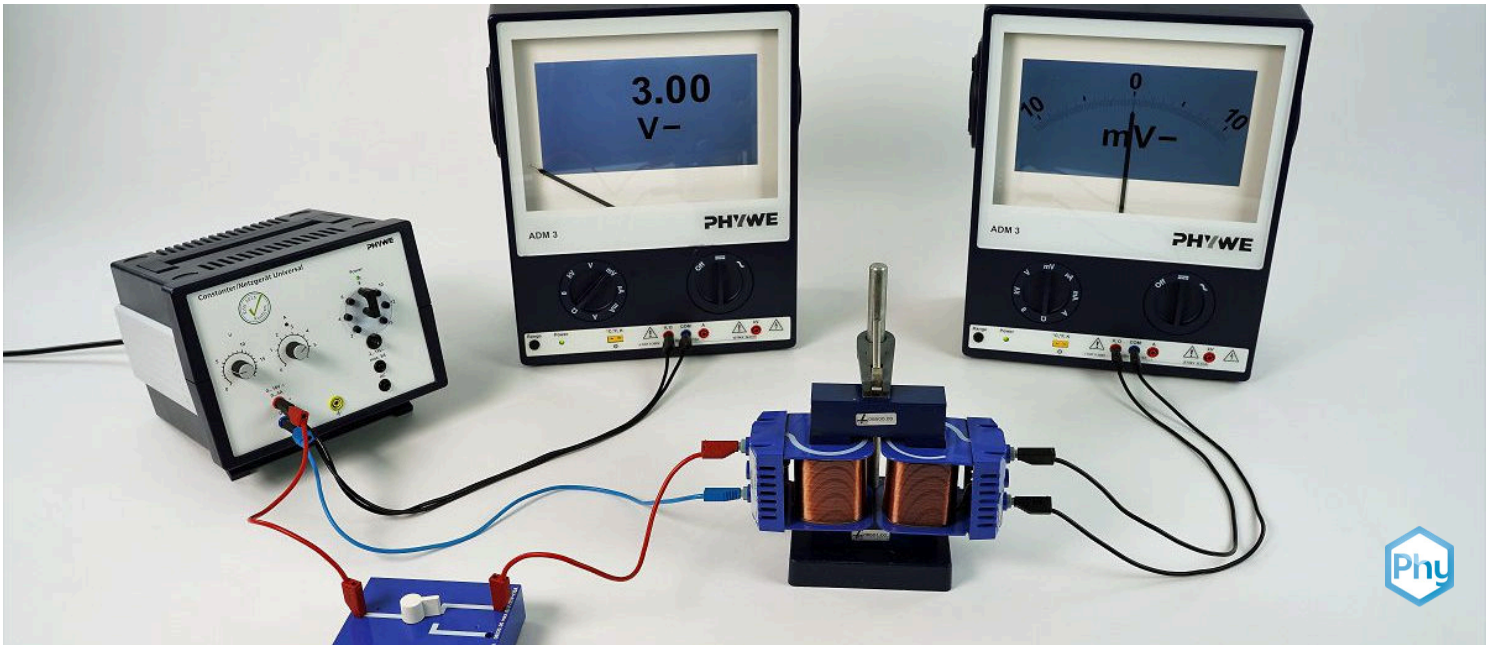
Voltage transformation (DEMO)



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:

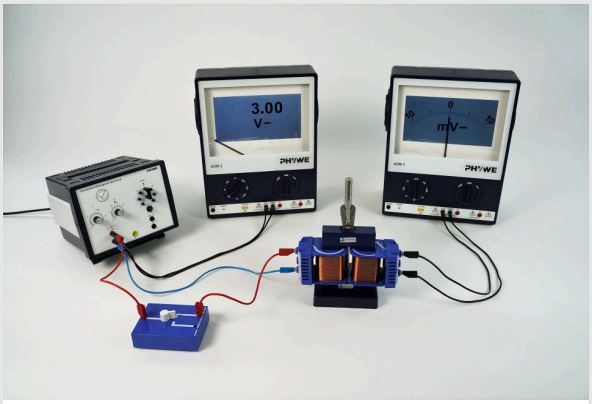
http://localhost:1337/c/6478fc99d57c800002376cdf

PHYWE

Teacher information

Application

PHYWE



Experimental setup

Transformers are needed to transform an input voltage higher, lower or equal. Voltage transformers are usually built into the power supply unit of many electrical devices.

In this experiment, the relationship between the number of turns and the input and output voltage is investigated.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

PHYWE

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.

The ratio of the number of turns of the primary and secondary coils on the ideal transformer results in the ratio of the primary and secondary voltage:

$$\frac{N_p}{N_s} = \frac{U_p}{U_s}$$

Other teacher information (2/2)

PHYWE

Learning objective

Students should understand how AC voltages can be converted to lower and higher voltages.

Tasks

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

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

PHYWE

Student information

Motivation

PHYWE

Transformers are needed to transform an input voltage higher, lower or equal. Voltage transformers are usually built into the power supply unit of many electrical devices.

In this experiment, the relationship between the number of turns and the input and output voltage is investigated.

Transformer station

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Equipment

Position	Material	Item No.	Quantity
1	PHYWE Power supply, universal, analog display DC: 18 V, 5 A / AC: 15 V, 5 A	13503-93	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, 1200 turns	06515-01	1
9	Two-way switch, single pole	06005-00	1
10	Connecting cord, 32 A, 750 mm, black	07362-05	4
11	Connecting cord, 32 A, 750 mm, blue	07362-04	1
12	Connecting cord, 32 A, 750 mm, red	07362-01	2

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Set-up and Procedure (1/3)

PHYWE

- Set the measuring range 10V- for the primary voltage U_P and the measuring range 3V- for the secondary voltage U_S.
- Press the U-core and yoke firmly together using the clamping device.
- Switch on the variable transformer and set the voltage to 4 V-.
- Close and open the switch several times. Observe the voltmeter in the secondary circuit.
- With the switch open, select the measuring ranges 10 V~ and apply a voltage of about 2 V~ instead of 4 V-.

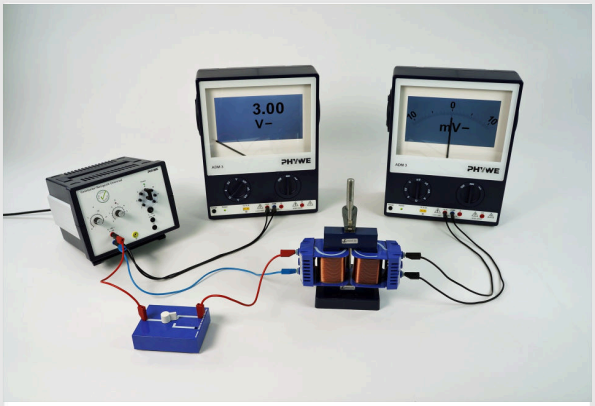


Fig. 1

Set-up and Procedure (2/3)

PHYWE

- Close the switch and measure the voltage U_P (across the primary coil) and U_S (across the secondary coil). Enter the measured values in the table in the report.
- Successively increase U_P in appropriate increments. Measure the respective values for U_P and U_S and note them in the table.
- With the switch open, replace the primary coil with 300 Wdg. with the coil with 1200 Wdg. Select the measuring range 3 V~ for U_S.

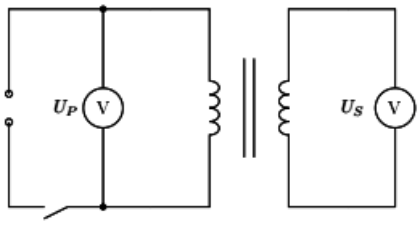


Fig. 2

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

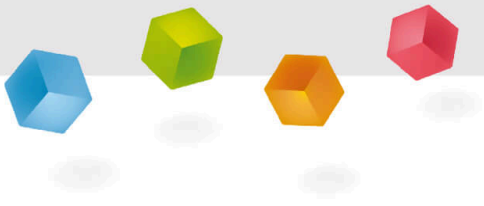
info@phywe.de
www.phywe.de

Set-up and Procedure (3/3)

PHYWE

- Close the switch and increase the voltage on the primary coil one after the other as before. Measure U_P and U_S and note the measured values in the table.
- With the switch open, swap the coils. To do this, install the transformer in the circuit rotated by 180° so that $N_P = 300$ and $N_S = 1200$ now apply. Set the measuring range 30V~ for U_S.
- Close the switch. Choose suitable values for U_P and write down U_S measure and write down measured values in the table.
- Finally remove the yoke and measure U_S for the last set value for U_P. Enter the measured values.

PHYWE



Report

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task (1/5)

Drag the words into the correct boxes!

Every time the _____ circuit is closed or _____, the _____ above the _____ coil momentarily swings a little to the right or left.

secondary
voltage meter
opened
primary

Check

Task (2/5)

N_P	N_S	U_P	U_S	N_P/N_S	U_P/U_S
300	300				
300	300				
300	300				
1200	300				
1200	300				
1200	300				

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Task (3/5)

PHYWE

N_P	N_S	U_P	U_S	N_P/N_S	U_P/U_S
300	1200				
300	1200				
300	1200				
Measurement without yoke:		–	–	–	–
300	1200				

Task (4/5)

PHYWE

Drag the words into the correct boxes!

The measuring device for U_S in the first part of the experiment fails because when the current is switched on and off through the _____, a _____ builds up or decays in it each time, which also passes through the secondary coil. The short-term magnetic field changes lead to short-term _____ in the _____, which in turn lead to the deflections of the voltmeter on the secondary coil.

secondary coil
primary coil
magnetic field
induction voltages

Check

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Task (5/5)

PHYWE

Drag the words into the correct boxes!

This explains the principle of operation of a _____. It consists of a field coil (_____) and an induction coil (_____), which have a common closed iron core. If an _____ is applied to the primary coil, then an AC voltage is induced in the secondary coil.

primary coil
secondary coil
transformer
AC voltage

Check

Slide	Score / Total
Slide 12: Switching on and off	0/4
Slide 15: Induction voltages during switching operations	0/4
Slide 16: Mode of operation of the transformer	0/4

Total score 0 / 12

Show solutions | Repeat | Export text

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de