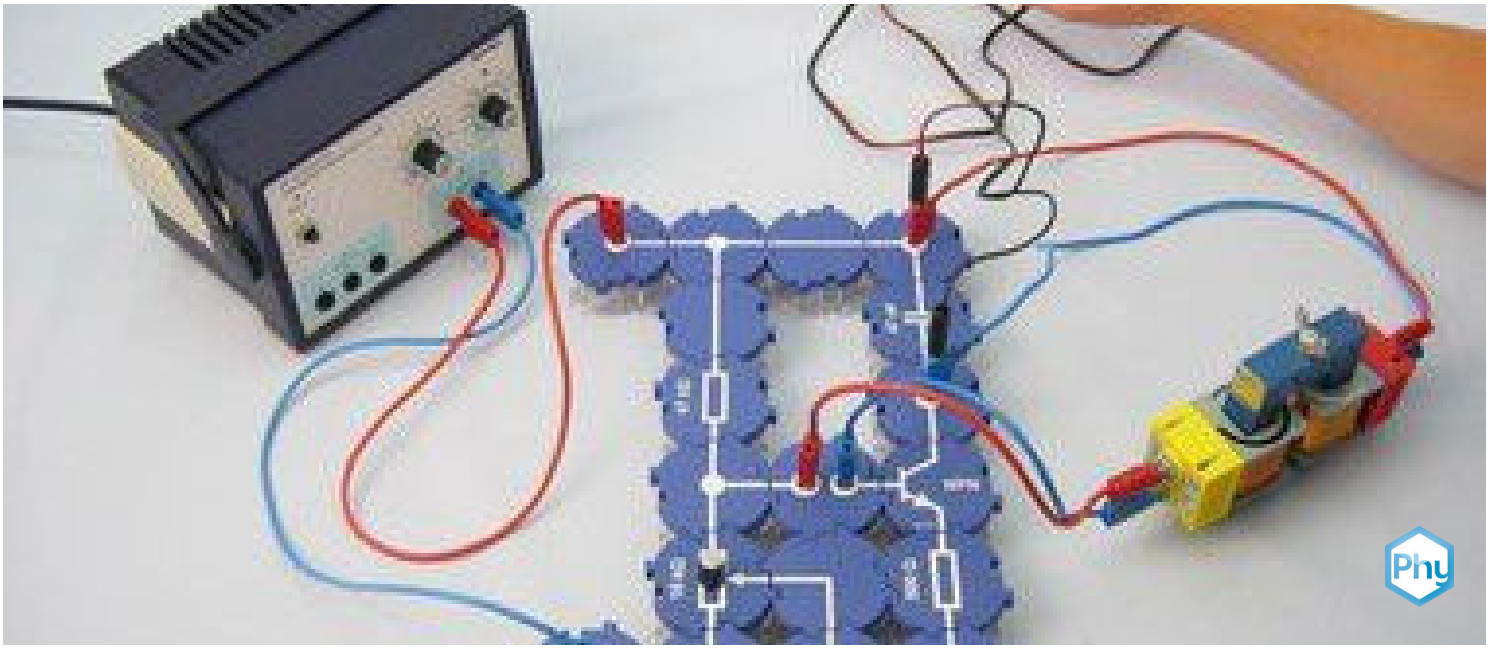
Undamped electromagnetic oscillations



The students should recognise from the experiment how an electromagnetic oscillating circuit can be damped down.

Physics > Electricity & Magnetism > Electromagnetic oscillations & waves

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/631a2fbdbce983000371042e

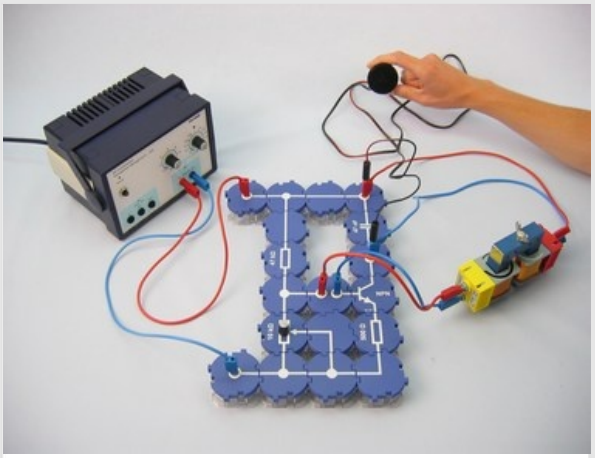
PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

PHYWE

Teacher information

Application

PHYWE



Experimental setup

The principle of damping an oscillating circuit by feedback is to be made understandable by means of the Meissner oscillating circuit used in this experiment.

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

Students should be familiar with how a resonant circuit works.

Principle

A system consisting of an amplifier and a feedback circuit can excite itself to oscillations of a certain frequency if the amplification at least compensates for the amplitude loss in the feedback circuit and the feedback voltage is in phase with the amplified voltage at the desired frequency.

Other teacher information (2/2)

PHYWE

Learning objective

The students should recognise from the experiment how an electromagnetic oscillating circuit can be damped down.

Tasks

Excites an oscillating circuit by feedback via a transistor amplifier stage to undamped electromagnetic oscillations.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Safety instructions

PHYWE

- The general instructions for safe experimentation in science lessons apply to this experiment.

PHYWE

Student information

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

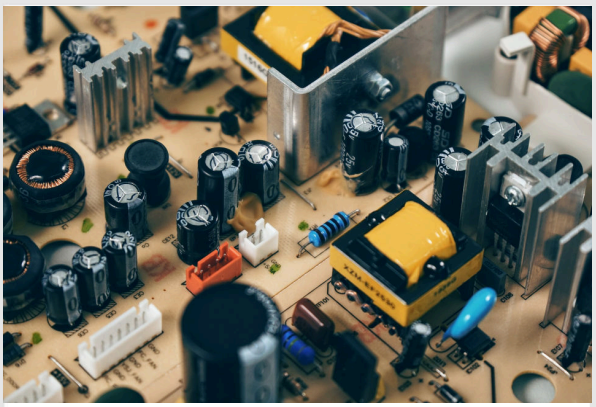
info@phywe.de
www.phywe.de

Motivation

PHYWE

A system consisting of an amplifier and a feedback circuit can excite itself to oscillations of a certain frequency if the amplification at least compensates for the amplitude loss in the feedback circuit and the feedback voltage is in phase with the amplified voltage at the desired frequency.

The principle of damping an oscillating circuit by feedback is to be made understandable by means of the Meissner oscillating circuit used in this experiment.



Switching system

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	Straight connector module, SB	05601-01	3
2	Angled connector module, SB	05601-02	2
3	T-shaped connector module, SB	05601-03	4
4	Interrupted connector module with sockets, SB	05601-04	1
5	Junction module, SB	05601-10	2
6	Straight connector module with socket, SB	05601-11	1
7	Angled connector module with socket, SB	05601-12	1
8	Resistor module 500 Ohm, SB	05613-50	1
9	Resistor module 47 kOhm, SB	05615-47	1
10	Potentiometer module 10 kOhm, SB	05625-10	1
11	NPN transistor module BC337, SB	05656-00	1
12	Capacitor module 47 nF, SB	05642-47	1
13	Capacitor module 47 µF non-polar electrolytic, SB	05645-47	1
14	Earphones with 4mm-plugs	06811-01	1
15	Coil, 400 turns	07829-01	1
16	Coil, 1600 turns	07830-01	1
17	Iron core, U-shaped, laminated	07832-00	1
18	Iron core, I-shaped, laminated	07833-00	1
19	Connecting cord, 32 A, 250 mm, red	07360-01	1
20	Connecting cord, 32 A, 250 mm, blue	07360-04	1
21	Connecting cord, 32 A, 500 mm, red	07361-01	2
22	Connecting cord, 32 A, 500 mm, blue	07361-04	2
23	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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

Set-up

PHYWE

- Place both coils on the U-core.
- Place the yoke on the U-core.
- Set up the experiment according to Fig. 1 and Fig. 2.

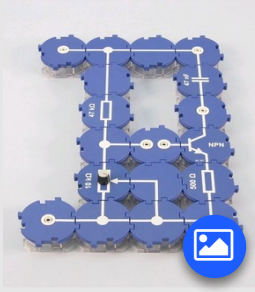


Fig. 1

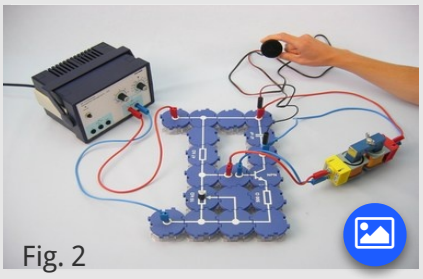


Fig. 2

Procedure (1/2)

PHYWE

- Switch on the power supply unit and set the DC voltage to 10 V-.
- Change the potentiometer. Make sure that the headphones produce a sound.
- Adjust the potentiometer so that the sound is quieter. If no sound is heard, swap the connections on one coil and repeat the experiment.
- **1st task:** Lift the yoke from the U-core, vary the distance between yoke and U-core and pay attention to the pitch. Note your observation in the report.
- **2nd task:** Remove the yoke from the U-core. Slide the 1600 turns coil back and forth on the U-core. Make a note of your observation in the report.
- **Task 3:** Pull the coil 400 turns. slowly from the U-core and listen to the sound. Write down your observation in the report.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

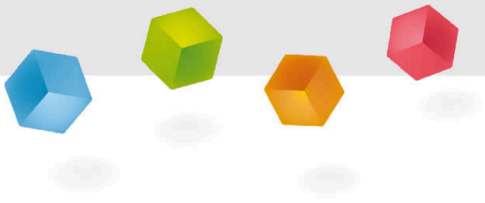
info@phywe.de
www.phywe.de

Procedure (2/2)

PHYWE

- **Task 4:** Swap the connections to a coil and change the potentiometer. Make a note of your observation in the report and return the connections to the original arrangement.
- Switch off the power supply unit. Replace the 500 Ω resistor with the line component and use the 47 µF capacitor for the oscillating circuit. Place the yoke on the U-core.
- **Task 5:** Switch on the power supply again. Lift the yoke from the U-core a little and note your observation in the report.
- Switch off the power supply unit.

PHYWE



Report

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Observation (1/5)

PHYWE

Make a note of your observations on the first task.

Observation (2/5)

PHYWE

Make a note of your observations on the 2nd task.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Observation (3/5)

PHYWE

Make a note of your observations on the 3rd task.

Observation (4/5)

PHYWE

Make a note of your observations on the 4th task.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Observation (5/5)

PHYWE

Make a note of your observations on the 5th task.

Task (1/6)

PHYWE

What is the relationship between the pitch and the frequency of a tone?

- The higher the frequency, the lower the tone.
- There is no correlation between frequency and pitch.
- The sound comes from acoustics, the frequency from optics. It is not possible to establish a connection here.
- The higher the frequency, the higher the sound.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Task (2/6)

PHYWE

The oscillating circuit used consists of 3 functional parts, the oscillating circuit, the feedback and the amplifier. Name the components that belong to these functional parts.

Task (3/6)

PHYWE

Why does the frequency of the tone change when the yoke is moved or the coil on the core is shifted?

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Task (4/6)

PHYWE

Why do the oscillations stop when the coil with 400 turns is pulled off the iron core?

Task (5/6)

PHYWE

Why do undamped oscillations not occur when the connections on a coil are reversed?

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

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

info@phywe.de
www.phywe.de

Task (6/6)

PHYWE

Drag the words into the correct boxes!

Unmodulated oscillating circuits are used to generate the _____ of computers or electric clocks. In modulated _____ circuits, amplitude, _____ or phase are influenced within certain limits by additional _____. This makes it possible to transmit _____ by modulation.

messages
oscillating
components
clock frequency
frequency

Check

Slide	Score / Total
Slide 18: Pitch	0/1
Slide 23: Applications	0/5

Total score 0 / 6

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