The Zener diode as voltage stabiliser (Item No.: P1378000)

Curricular Relevance

Area of Expertise: Physik
Education Level: Klasse 10-13
Topic: Elektrizitätslehre
Subtopic: Elektronik
Experiment: Die Z-Diode als Spannungsstabilisator

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional information

The sharp increase in the characteristic current-voltage curve for Zener diodes above the breakdown voltage makes it suitable for stabilising small direct voltages. When the input voltage is increased beyond the breakdown voltage, the current increases sharply while the diode resistance gets smaller and smaller. Therefore, the voltage at the Zener diode remains nearly constant. A resistor must be insert to ensure that the maximum allowable dissipation power for the Zener diode is not exceeded.
If a load resistor is connected in parallel to the Zener diode, the current flowing through the Zener diode is reduced in favour of the load current. Stabilisation is interrupted when there is no more current flowing through the Zener diode. For this reason, the use of Zener diodes is limited to relatively small load currents. Electronic regulation circuits are used for larger loads.
There is a closely graduated selection of Zener diodes in the voltage range of 3 V to 200 V, meaning that there are diode types for any desired voltage.

Notes on setup and procedure

If there are not enough multi-range meters for each experiment group to have two, the voltage values set on the potentiometer on the power supply unit can be used, or a connection cord can be connected to the voltmeter alternating between the input and output of the circuit.
Make sure that the students plug in the Zener diode in the reverse direction.

Remarks

Besides their use in stabilising direct voltage at a relatively small load, Zener diodes are also used for creating a stabile reference voltage in regulation circuits, for protecting devices, components, or meters from excessive voltage, or for suppressing the lower measurement range of voltmeters.

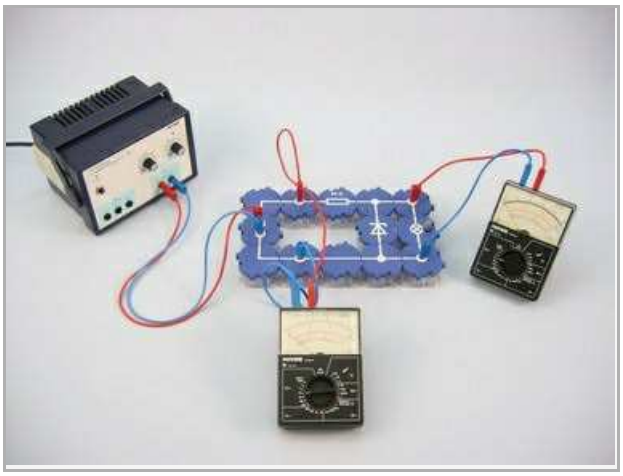
The Zener diode as voltage stabiliser (Item No.: P1378000)

Task and equipment

Task

How can a Zener diode be used to stabilise direct voltage?

Investigate the functioning of a voltage stabiliser with a Zener diode.



Equipment

Position No.	Material	Order No.	Quantity
1	Straight connector module, SB	05601-01	1
2	Angled connector module, SB	05601-02	2
3	T-shaped connector module, SB	05601-03	2
4	Interrupted connector module, SB	05601-04	1
5	Straight connector module with socket, SB	05601-11	1
6	Angled connector module with socket, SB	05601-12	1
7	Socket module for incandescent lamp E10, SB	05604-00	1
8	Resistor module 50 Ohm, SB	05612-50	1
9	Z-diode module ZF4.7, SB	05652-00	1
10	Connecting cord, 32 A, 250 mm, red	07360-01	1
11	Connecting cord, 32 A, 250 mm, blue	07360-04	1
12	Connecting cord, 32 A, 500 mm, red	07361-01	2
13	Connecting cord, 32 A, 500 mm, blue	07361-04	2
14	Filament lamps 4V/0.04A, E10, 10	06154-03	1 piece
15	Multi-range meter, analogue	07028-01	2
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 experiment as shown in Fig. 1 and Fig. 2. Select a measurement range of 10 V- on both meters. Make sure that the polarity is correct.
Note: If you only have one meter, use the scale on the power supply unit to determine U_1.

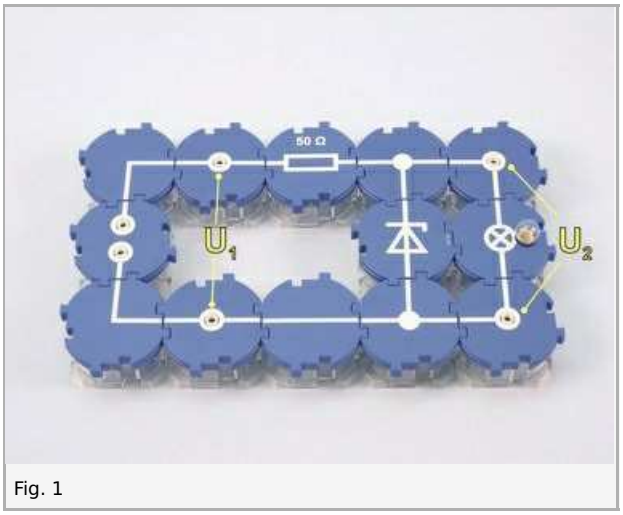


Fig. 1

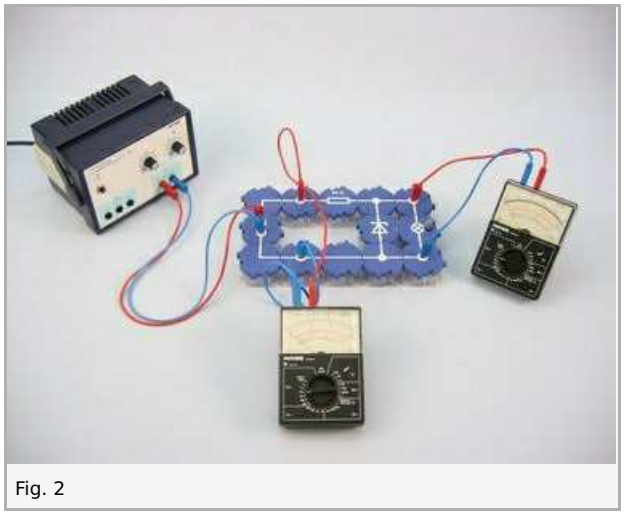


Fig. 2

Procedure

- Switch on the power supply unit. Increase the voltage U_1 from 0 V to 10 V in increments of 1 V. Measure U_1 and U_2 and enter the values in Table 1 in the report.
- Remove the meter for U_1 from the circuit. Vary the voltage U1 between 8...10 V and observe the meter and the filament lamp. Note your observations under Result - Observations 1.
- Set the voltage on the power supply unit to 10 V. Unscrew the filament lamp and screw it back in several times. Observe the meter and note your observations under Result - Observations 2.
- Switch off the power supply unit.

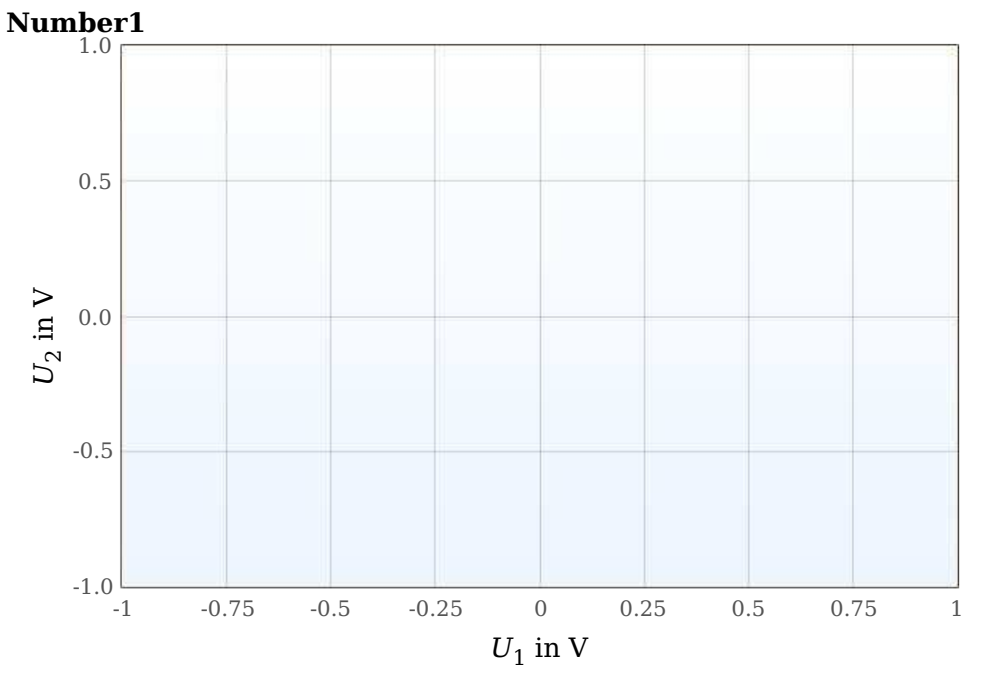
Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

Report: The Zener diode as voltage stabiliser

Result - Table 1

Record your measured values.

U_1 in V	U_2 in V
1	1 ±0
2	1 ±0
3	1 ±0
4	1 ±0
5	1 ±0
6	1 ±0
7	1 ±0
8	1 ±0
9	1 ±0
10	1 ±0



Result - Observations 1

Note your observations.

.....

.....

.....

.....

Result - Observations 2

The filament lamp lights up: U_2 = ... V.

The filament lamp does not light up: U_2 = ... V.

Evaluation - Question 1

Compare the change in the output voltage U_2 with the change in the input voltage U_1 in the range 8 V ≤ U_1 ≤ 10 V.

.....

.....

.....

.....

Evaluation - Question 2

Specify the input voltage at which the stabilising function of the Zener diode takes effect.

.....

.....

.....

.....

Evaluation - Question 3

How does the circuit behave when the load is changed?

.....

.....

.....

.....

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com