The transistor as a direct current amplifier (Item No.: P1383200)

Curricular Relevance
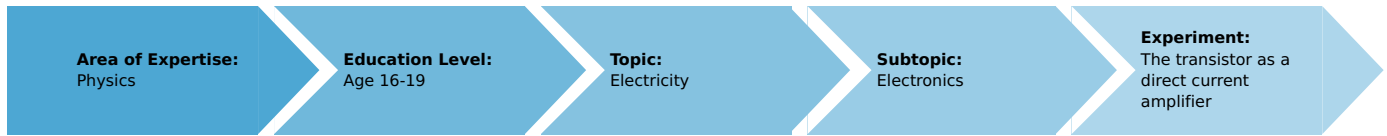
| Area of Expertise: Physics | Education Level: Age 16-19 | Topic: Electricity | Subtopic: Electronics | Experiment: The transistor as a direct current amplifier |

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

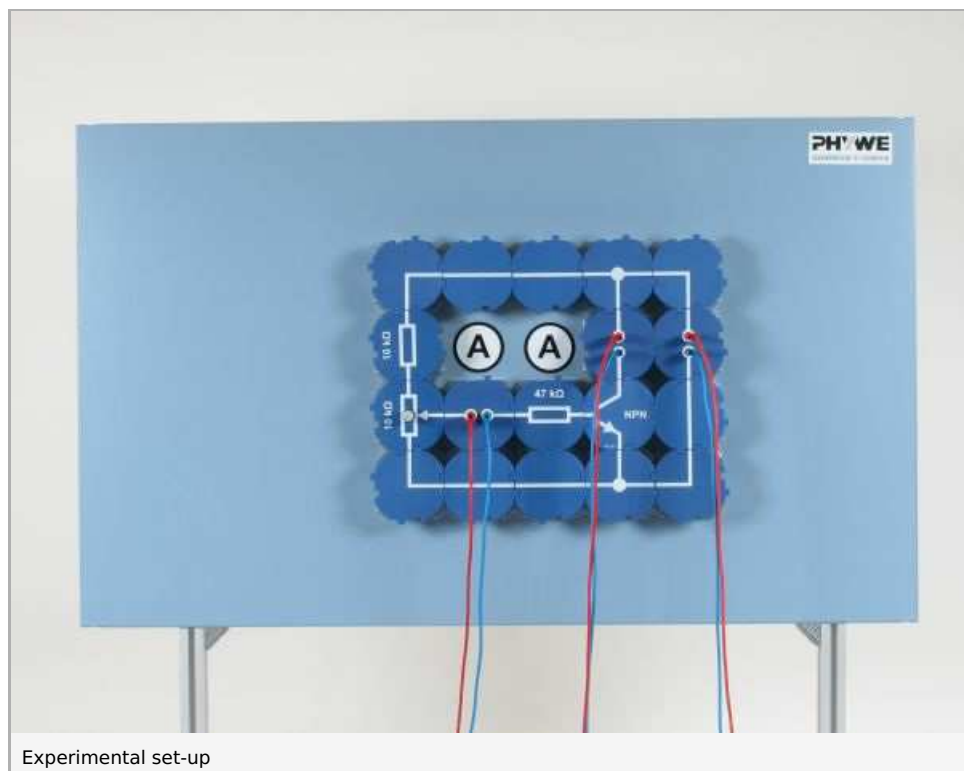| **Additional Requirements:**	**Experiment Variations:**

Keywords:

Principle and equipment

Principle

The relationship between the change in the collector current and the change in the base current – the current amplification of the transistor – is to be determined.
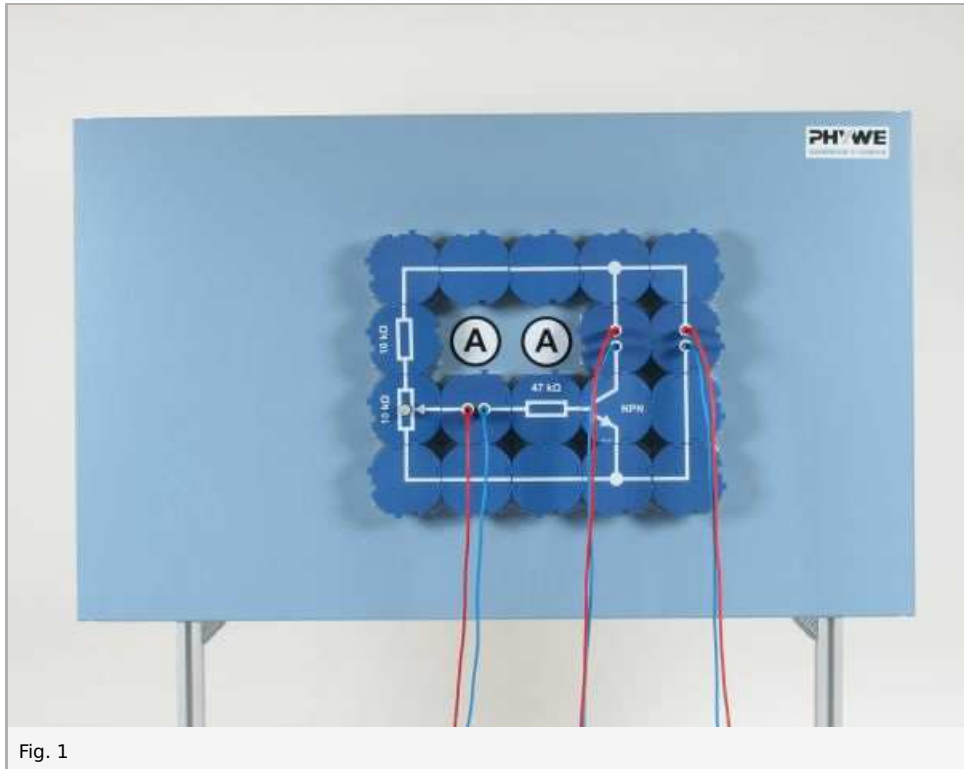

Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	2
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Potentiometer 10 kOhm,module DB	09425-10	1
5	Transistor BC337,module DB	09456-00	1
6	Connector interrupted, module DB	09401-04	3
7	Resistor 47 kOhm,module DB	09415-47	1
8	Resistor 10 kOhm,module DB	09415-10	1
9	Electr.symbols f.demo-board,12pcs	02154-03	1
10	Connector, straight, module DB	09401-01	5
11	Connector, angled, module DB	09401-02	4
12	Connector, T-shaped, module DB	09401-03	2
13	Connecting cord, 32 A, 1000 mm, red	07363-01	3
14	Connecting cord, 32 A, 1000 mm, blue	07363-04	3

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Set-up and procedure

- Connect up the circuit as shown in Fig. 1, ensuring correct polarity of the measuring instruments; select the 100 µA-measurement range for the base current, and 100 mA- for the collector current.
  Note: The collector current should not be adjusted to more than 60 mA at a voltage of 10 V, as it would then exceed the maximum permissable power dissipation $P_{\mathrm{Vmax}} = 625 \ \mathrm{mW}$ of a transistor of type BC 337.

- Set the power supply voltage to 10 V- and do not change this during the experiment.

- First adjust the potentiometer so that no collector current flows; then increase the base current in 10 µA steps and enter the measured values for the collector current in Table 1.

Fig. 1

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Observation and evaluation

Observation

$\frac{I_B}{\mu A}$	0	10	20	30	40	50	60	70	80
$\frac{I_C}{mA}$	0	10	15	20	27	34	42	50	60

Evaluation

It can be seen from the graphical representation of the measured values (Fig. 2), that the collector current increases much more strongly than the base current.

In a transistor, therefore, a small change in the base current causes a large change in the collector current. From the triangles drawn in at the curve, we find that a base current change of $\Delta I_B = 10\ \mu A$ causes an increase in the collector current $\Delta I_C = 7\ \mathrm{mA}$. This transistor therefore has a current amplification of:
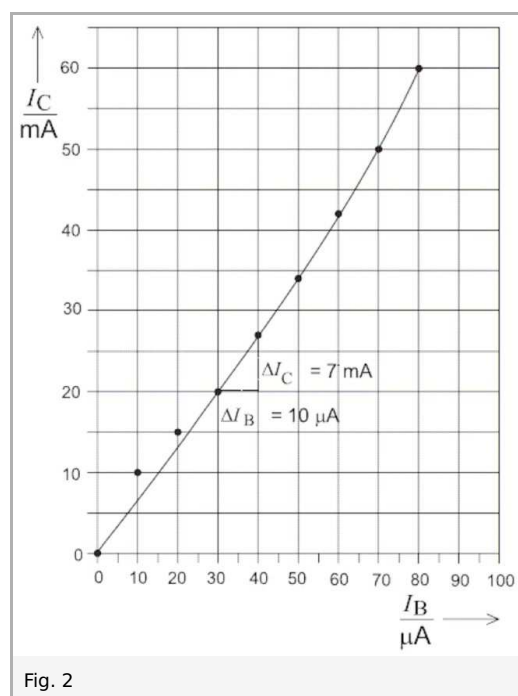
$\beta = \Delta I_C / \Delta I_B = 700$.

Fig. 2

Remarks

Transistor manufacturers separate transistors into current amplification groups. As an example, current amplification group D has amplification values within the range of 350 to 700. Should the transistor be one which deviates strongly from the average value, it might be necessary to select a different measurement range for the measurement of the base current.

The dependence of the collector current on the base current is only approximately represented by a straight line. The current amplification is therefore not the same for all values of the collector current. It also depends on the temperature and on the collector voltage.

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