# 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:**

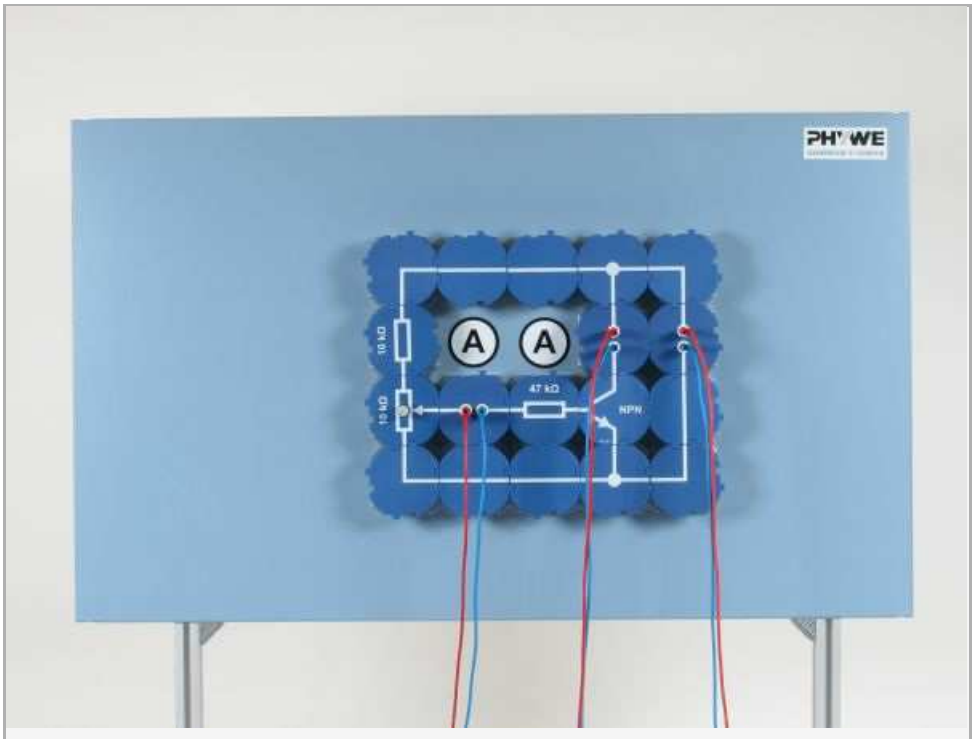
**Experiment Variations:**

**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.

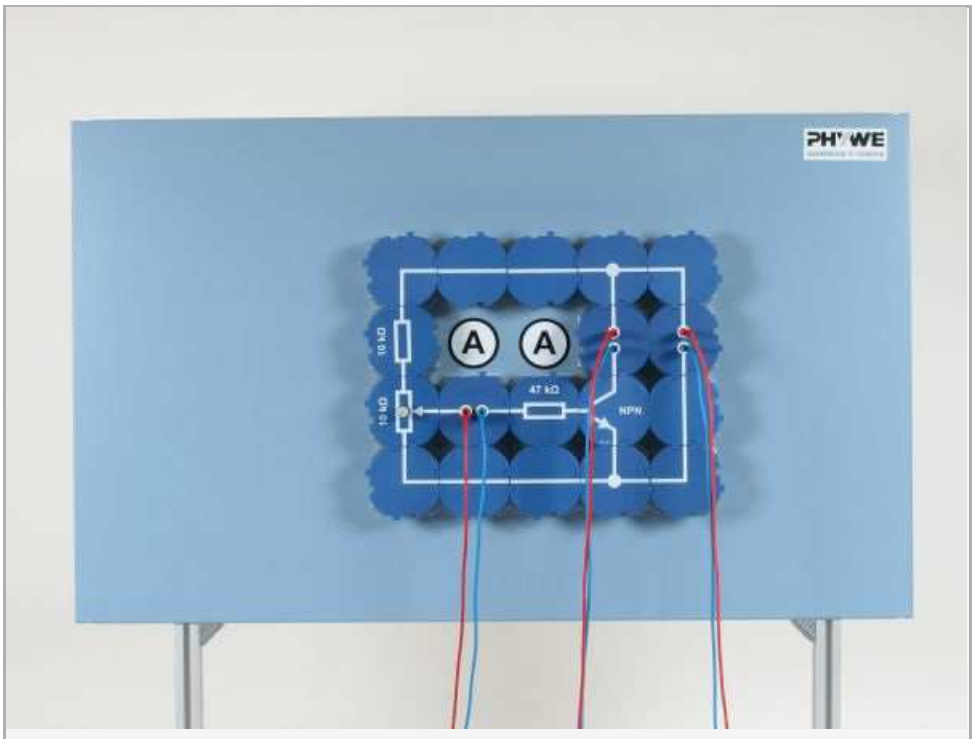


Fig. 1

# 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 $\Delta I_B = 10\ \mu\mathrm{A}$ causes an increase in the collector current $\Delta I_C = 7\ \mathrm{mA}$. This transistor therefore has a current amplification of:

$\beta = \Delta I_C / \Delta I_B = 700$.

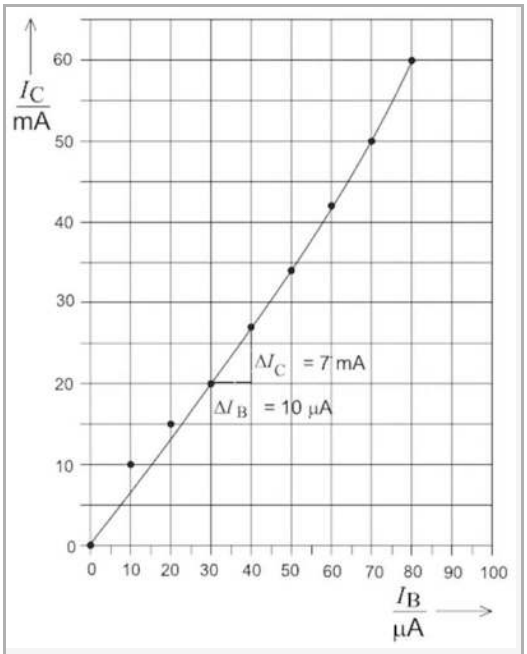


Fig. 2

## 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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