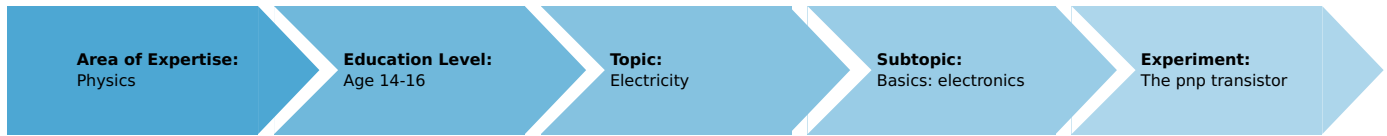


The pnp transistor (Item No.: P1383600)

Curricular Relevance



Difficulty



Difficult

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

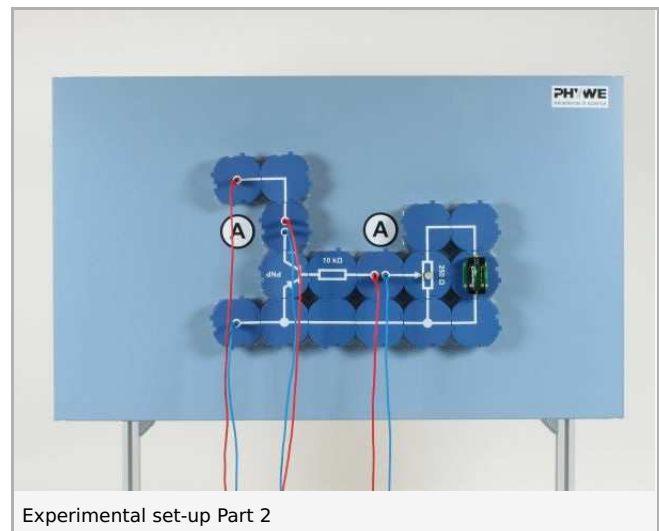
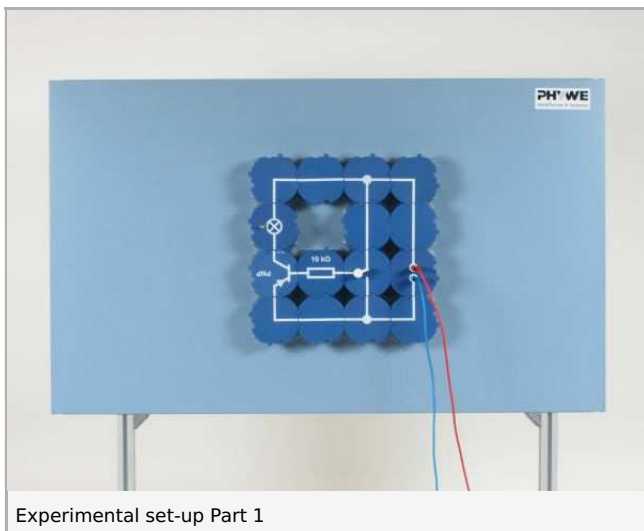
Experiment Variations:

Keywords:

Principle and equipment

Principle

A demonstration is to show with which voltage a pnp transistor can be operated, and in which way the collector current is dependent on the base current and the collector voltage.



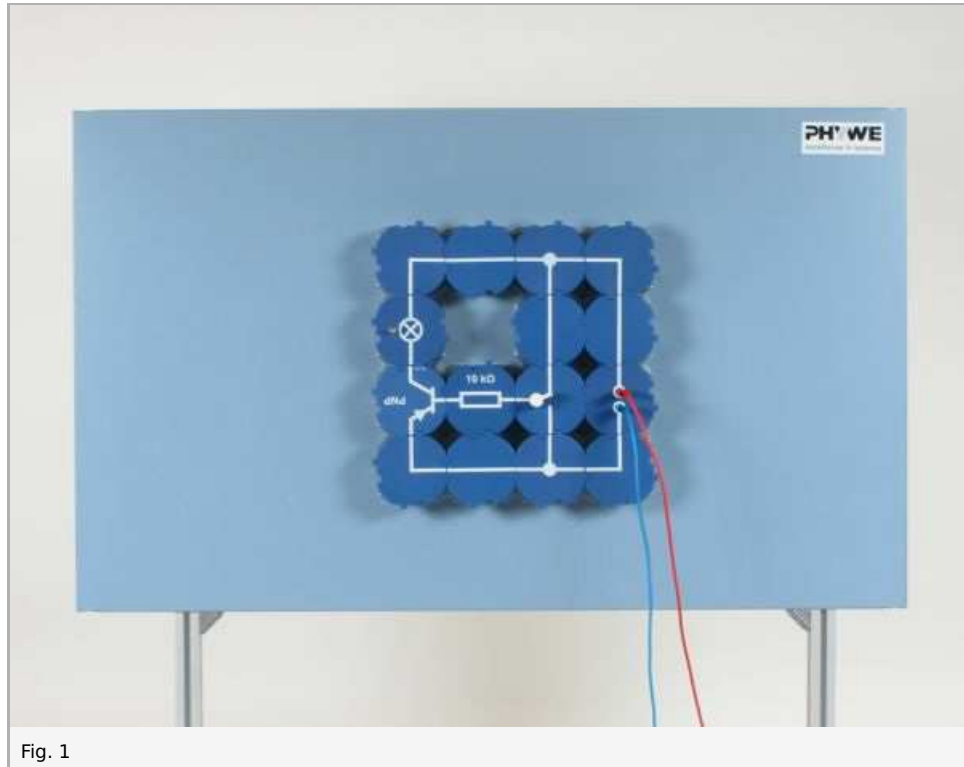
Equipment

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	Switch, change-over, module DB	09402-02	1
5	Potentiometer 250 Ohm, module DB	09423-25	1
6	Transistor BC327,module DB	09457-00	1
7	Socket for incandescent lamp E10 ,module DB	09404-00	1
8	Connector interrupted, module DB	09401-04	3
9	Junction, module DB	09401-10	2
10	Resistor 10 kOhm,module DB	09415-10	1
11	Electr.symbols f.demo-board,12pcs	02154-03	1
12	Connector, straight, module DB	09401-01	3
13	Connector, angled, module DB	09401-02	4
14	Connector, T-shaped, module DB	09401-03	2
15	Battery holder module (C type), SB	05605-00	1
16	Filament lamps 12V/0.1A, E10, 10 pieces	07505-03	1
17	Connecting cord, 32 A, 1000 mm, red	07363-01	3
18	Connecting cord, 32 A, 1000 mm, blue	07363-04	3
19	Battery cell, 1.5 V, baby size, type C	07922-01	1

Set-up and procedure

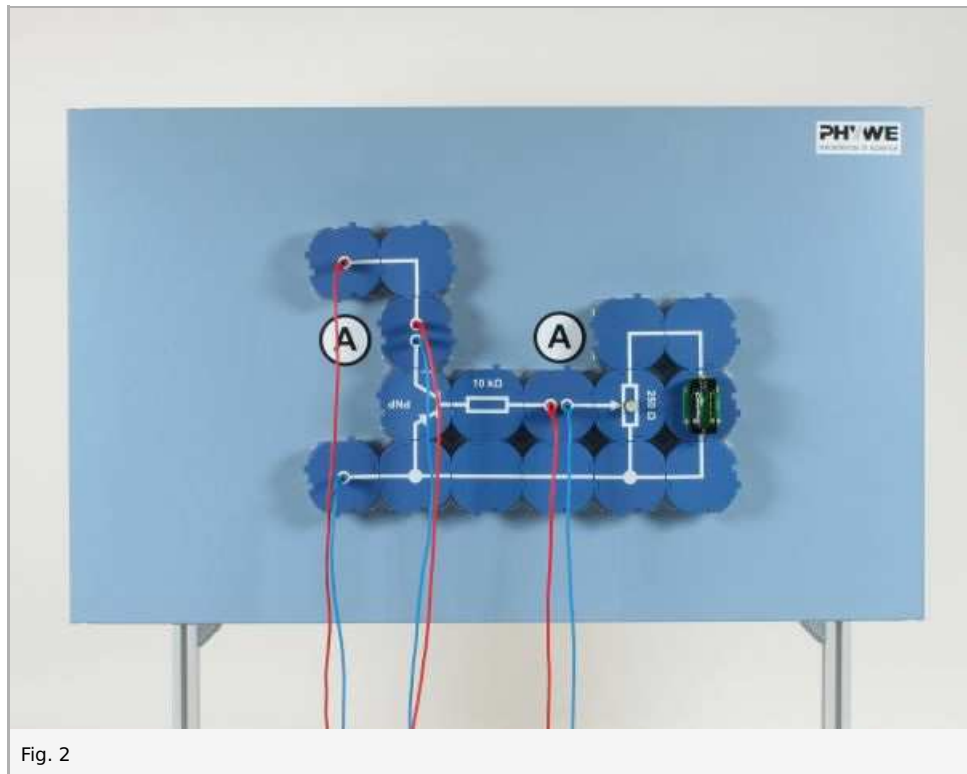
1st. Experiment

- Connect up the circuit as shown in Fig. 1; set the power supply voltage to 12 V-; connect the transistor emitter with the negative terminal of the current source.
- Operate the changeover switch several times, observe the lamp and note what you observe in Table 1.
- Reverse the connections to the power supply, so that the negative terminal of the current source is now connected to the transistor collector via the lamp.
- Operate the changeover switch several times, observe the lamp; note the result.



2nd. Experiment

- Connect up the circuit as shown in Fig. 2; select the 30 mA measurement range for the collector current and 100 μA for the base current; ensure correct polarity of the measuring instrument, the battery and the power supply.
- Adjust the potentiometer so that no current flows.
- Set the power supply voltage to 5 V- and leave it constant throughout the first series of measurements.
- Increase the base current up to 40 μA in steps of 5 μA ; measure the collector current for each value of the base current and enter it in Table 2.
- Bring the base current back to 10 μA , adjust the collector voltage to the values given in Table 3 and measure the collector current, keeping a check on the base current and correcting it if necessary; note the measured values.
- Now increase the base current in steps of 10 μA and, for each value of the base current, examine the dependence of the collector current on the collector voltage and note the measured values.



Observation and evaluation

Observation

Table 1

Collector connected to	Positive terminal		Negative terminal	
Base connected to	Positive terminal	Negative terminal	Positive terminal	Negative terminal
Lamp does not light up	x	x	x	
Lamp lights up				x

Table 2: I_C in dependence on I_B and at $U_{CE} = 5 \text{ V}$.

$\frac{I_B}{\mu A}$	5	10	15	20	25	30	35	40
U_{CE}	2.2	5.2	7.8	10.6	13.0	16.3	18.1	22.1

Table 3: I_C in dependence on U_{CE} and I_B

U_{CE}	1	2	4	6	8	10
$\frac{I_B}{\mu A}$						
10	4.2	4.4	4.9	5.2	5.7	5.9
20	8.9	9.4	10.1	11.0	12.1	13.2
30	13.7	14.3	15.4	16.9	18.3	20.9
40	18.7	19.5	21.2	23.2	25.5	28.3

Evaluation

A collector current only flows through a transistor when the collector and the base are connected to the negative terminal of the current source. Fig. 3. is a plot of the measured values in Table 2. The collector current increases much more strongly than the base current.

At a collector voltage of $U_{CE} = 5V$ the current amplification of the pnp transistor $B = \Delta I_C / \Delta I_B = 600$. The characteristic curves in Fig. 4 are plots of the measured values in Table 3. From the characteristic curve field, it can be seen that the collector current at the various base current values is dependent on the collector voltage. These characteristic output curves show that the collector current first increases very steeply with an increase in collector voltage. From a voltage of about 1 V upwards, however, the curves are relatively flat. The collector current increases only a little with further increase of collector voltage. The ratio $\Delta U_{CE} / \Delta I_C$ is the output resistance R_a of the transistor. As an example, at a base current of $20 \mu A$, $R_a = \Delta U_{CE} / \Delta I_C = 2k\Omega$.

