

Investigating the diode properties of transistor junctions

Objects of the experiment

- Investigating the conducting-state and reverse directions for the different junctions of a npn- and a pnp-transistor

Principles

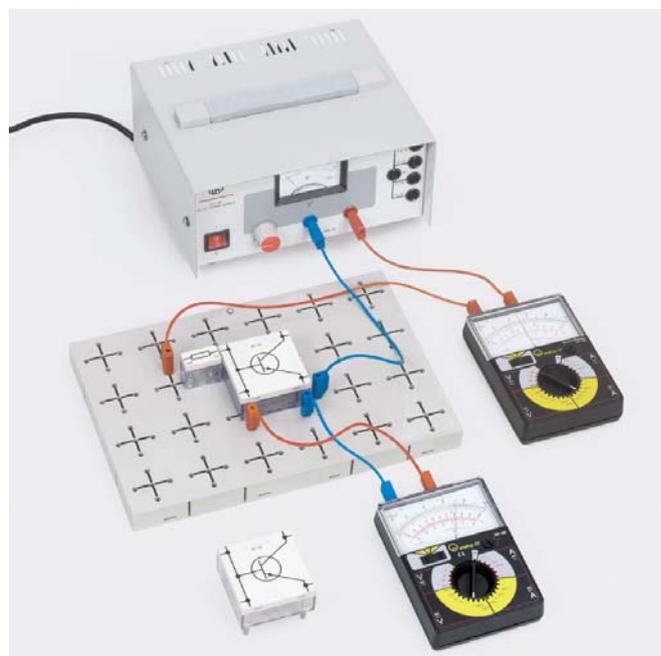
Transistors are among the most important semiconductor components in electronic circuit technology. In bipolar transistors the electrons and holes are both involved in conducting current. The electrodes of a bipolar transistor are called the emitter, the base and the collector. The transistor consists of a total of three n-conducting and p-conducting layers, in the order npn or pnp. The base layer, located in the middle, is so thin that charge carriers originating at one junction can cross to the other junction.

The experiment examines the principle of the bipolar transistor and compares it with a diode. Here, the difference between an npn and a pnp transistor is explicitly investigated.

Apparatus

1 Rastered socket panel DIN A 4	576 74
1 STE Resistor 100 Ω , 2 W	577 32
1 STE Transistor BD 137, NPN	578 67
1 STE Transistor BD 138, PNP	578 68
1 AC/DC Power supply 0...12 V / 3 A	521 485
2 Multimeters LDanalog 20	531 120
3 Pair cables 50 cm, red/blue	501 45

Setup



Carrying out the experiment

- Set up the experiment as shown in the figure. Plug in the npn-transistor BD 137.
- Junction base-emitter EB: Connect the power supply with the positive polarity to the base B and the negative polarity to the emitter E of the transistor. Pay attention of the measuring range and polarity of the multimeters.
- Carefully increase voltage U – starting with 0 V – and observe current I up to $I = 5$ mA reading the value for the corresponding voltage U . The voltage U should not exceed 2 V.
- Fill in the pair of voltage U and current I in the table 1.
- Reverse polarity and repeat the experiment and complete table 1.

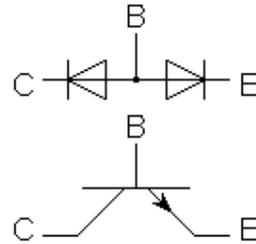
- Junction base-collector BC: Connect the power supply with the positive polarity to the base B and the negative polarity to the collector C of the transistor. Pay attention of the measuring range and polarity of the multimeters.
- Repeat the experiment and fill in the results in table 2.
- Junction collector-emitter CE Now connect the power supply with the positive polarity to the collector C, the resistor 100 Ω connected in serie, and the negative polarity to the emitter E of the transistor.
- Repeat the experiment and fill in the results in table 3.
- Repeat the complete experimental steps with the pnp-transistor BD 138. Fill in the results in tables 4, 5 and 6.

Evaluation and results

The base-collector and the base-emitter-junction of a transistors behave like diodes.

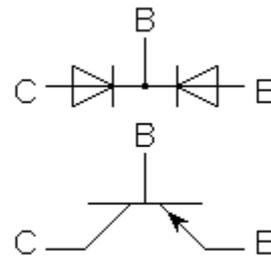
To visualize the behavior of a npn- or pnp-transistor following schematics can be used:

nnp-transistor:



If the the base of a npn-transistor is at positive polarity, both junctions - base-collector and base-emitter - are in the conducting state.

pnp-transistor:



If the the base of a pnp-transistor is at negative polarity, both junctions - base-collector and base-emitter - are in the conducting state.

Measuring example

NPN-Transistor BD 137

Table 1: Base-Emitter path

Base B	Emitter E	Current	$\frac{U_{BE}}{V}$	$\frac{I_B}{mA}$
+	-	yes	0,7	5
-	+	no	2	0

Table 2: Basis-Collector path

Base B	Collector C	Current	$\frac{U_{BC}}{V}$	$\frac{I_B}{mA}$
+	-	yes	0,7	5
-	+	no	2	0

Table 3: Collector-Emitter path

Collector C	Emitter E	Current	$\frac{U_{CE}}{V}$	$\frac{I_C}{mA}$
+	-	no	2	0
-	+	no	2	0

PNP-Transistor BD 138

Table 4: Base-Emitter path

Base B	Emitter E	Current	$\frac{U_{BE}}{V}$	$\frac{I_B}{mA}$
+	-	no	2	0
-	+	yes	0,7	5

Table 5: Base-Collector path

Base B	Collector C	Current	$\frac{U_{BC}}{V}$	$\frac{I_B}{mA}$
+	-	no	2	0
-	+	yes	0,7	5

Table 6: Collector-Emitter path

Collector C	Emitter E	Current	$\frac{U_{CE}}{V}$	$\frac{I_C}{mA}$
+	-	no	2	0
-	+	no	2	0