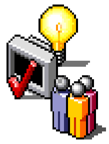
Training objectives and introduction



In this experiment we will be exploring and measuring the properties of a bipolar transistor on the basis of different characteristics.

Training content

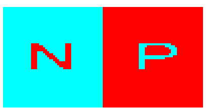
- Basic operation of a bipolar transistor
- Measuring the current control, input and output characteristics

Introduction

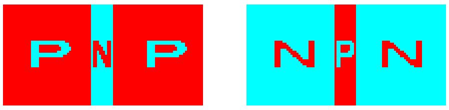
Transistors have revolutionised the world of electronics ever since they were introduced after the second World War. Their ever decreasing size and their tremendous versatility have made them into the most useful and important electronic components in existence. In the current course we will be dealing with two possible configurations of basic transistor circuits.

The first transistors, also known as bipolar transistors, comprised two semiconductor layers encapsulating a third layer. Semiconductor materials are characterised by, among other things, the property that the number of electrons which conduct electricity can be increased or decreased simply by adding impurities. This procedure is referred to as **doping**. This process is used to manufacture **n-type**, i.e. negative charged material with a surplus of electrons as well as **p-type**, i.e. positive materials featuring a relative deficiency of electrons. In the latter case, so-called holes arise which correspond to the missing electrons. These holes behave as if they were positive charge carriers similar to electrons which carry negative charges.

The two different types of material can be combined to make a single component. Here, the p-type material is arranged on one side and the n-type material is on the other so that a junction arises in the middle. This structure is a very good conductor of electricity if a positive voltage relative to the n-type's side is applied to the p-type side (constituting a forward bias). if, however, the component's n-type material connected to the positive end of the circuit (reverse bias), it is very difficult for the charge carriers (electrons and holes) to pass through the junction thus blocking the current flow. This is the basic operating principle of the **diode**, a component, which is conductive in one direction only.



Bipolar transistors feature semiconductor material of the same type on both sides with a thin layer of the opposite type in between. The two sides of the same type are designated collector and emitter zones, the layer in the middle is termed the base. At first glance, this arrangement looks like two interlinked diodes. You might expect that no current is able to flow between the collector and the emitter since a reverse voltage is always being applied to one of the two "diode junctions". The secret to this arrangement is in the thin layer of the base zone. Charge carriers can always bridge a small gap over the junction. If the base zone is supplied with additional charge carriers by applying a voltage to it, sufficient charge carriers are present to bridge the gap and current begins flowing. Due to the fact that the current flow between collector and emitter is only "switched on" when sufficient voltage and power is present at the base, these kinds of transistors can be used as electronic switches which can be switched on and off depending on the current supply to the base.



Just how much current flows between the collector and the emitter depends on the number of charge carriers in the base zone so that changes in the voltage and amperage at the base can lead to a stronger or weaker current flow between the collector and emitter. Even a slight change at the base can lead to a substantial change in voltage between collector and emitter. This relationship remains linear over a wide range: a modified voltage signal at the base is reproduced exactly between the collector and emitter but with considerable greater voltage change. Thus, the transistor serves to amplify the signal. This is the second conventional area of application for transistors.