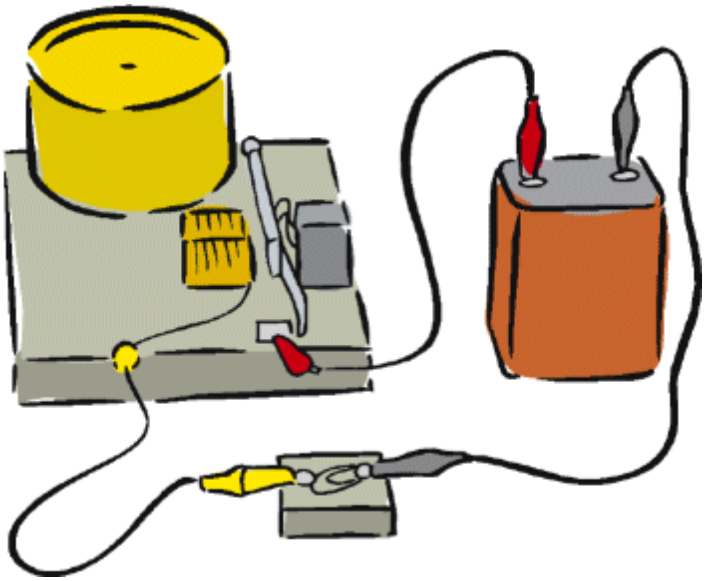
Light emitting diode



Training objectives and introduction

Light emitting diodes or LEDs are essential for many electronic circuits. On the following pages you will become familiar with various types and learn to characterise them on the basis of their threshold voltage.

In this experiment the threshold voltage of various light emitting diodes will be examined and compared to the threshold voltage of a silicon and germanium diode.

Introduction

Optoelectronics is a segment of electronics which involves the conversion of optical signals into electrical signals and viceversa. Optoelectronics also entails the coupling of optical and electronic signals. Knowledge of optoelectronics forms the foundation for its application in the area of communications engineering and in the transmission of optical signals via fibre optic waveguides.

Optical signals can be in located in the visible light range. In principle the range of optical radiation spans from infrared all the way into the ultraviolet range.

Standard light-emitting sources include:

- LEDs in diverse visible colours
- IR-LEDs
- Laser diodes

Standard light sensitive receivers include:

- Photoresistors
- Photodiodes
- Phototransistors
- Photothyristors
- Solar cells

LEDs

LEDs or light emitting diodes exist in various colours. The most common of these are red, green and yellow LEDs. In recent times blue LEDs have emerged thanks to requirements from the car industry (headlamp control lights). In addition to visible colours there are also LEDs which emit light which is invisible to the human eye, infrared light.

The current-voltage characteristics of LEDs differ only slightly from those of normal diodes. The break voltage of the characteristic depends on the colour of the LED.

Colour	*Threshold voltage*
IR	1.3 V
red	1.6 V - 1.8 V
orange	2.0 V
yellow	2.2 V
green	2.4 V
blue	4V - 4.5 V

The radiation strength is for all intents and purposes practically proportional to the diode current. However, LEDs possess limiting values which may not be exceeded as otherwise the component becomes damaged. The precise data on this can be taken from the manufacturer's data sheet.

Phototransistors

Like the photodiode the phototransistor is an optical signal detector. Various types of phototransistors have varing spectral sensitivity. For that reason they always have to be matched to the transmitter.
As in the case of a normal transistor, the phototransistor is equipped with an emitter and collector. But the base is not available to function as the third terminal. Instead the base-collector junction is designed with an expanded surface. When subject to light radiation a base current is evoked through photon absorption, which thanks to current amplification attracts an even larger collector-emitter current.

The family of output characteristics differ insignificantly from that of a standard transistor. The rise and fall times of commercially available phototransistors are at a few l's, while the limiting frequency is correspondingly at a few hundred kHz.

The transistor is already supplied by a fixed power supply of 15 V having a series resistor R6 = 18 kOhm at the collector upstream and the emitter connected to ground.

Optocouplers

When the emitter and receiver are integrated in a self-contained unit, this is referred to as a n optocoupler. Optocouplers serve primarily to isolate electrical potential. As such people are able to operate and control life-threatening voltages without any problems using optocouplers and photothyristors because the couplers keep the hazardous electrical potential at a distance. In the area of digital technology the isolation of electrical potential using optocouplers is needed to avoid "hum" from feedback loops.

Fork light barriers

Light barriers are a typical application of optoelectronics. If receiver and emitter are in very close proximity and permanently attached to a U-shaped fork, this is called a fork light barrier. Fork light barriers are used, for example, to count the increments of a rotating disc or simply to test whether a tool is present or not.

The fork light barrier found on the card OBP847 is equipped with both an

- IR-LED as well as a
- Phototransistor