

LIGHT SENSOR

with 3 measurement ranges

Description D033

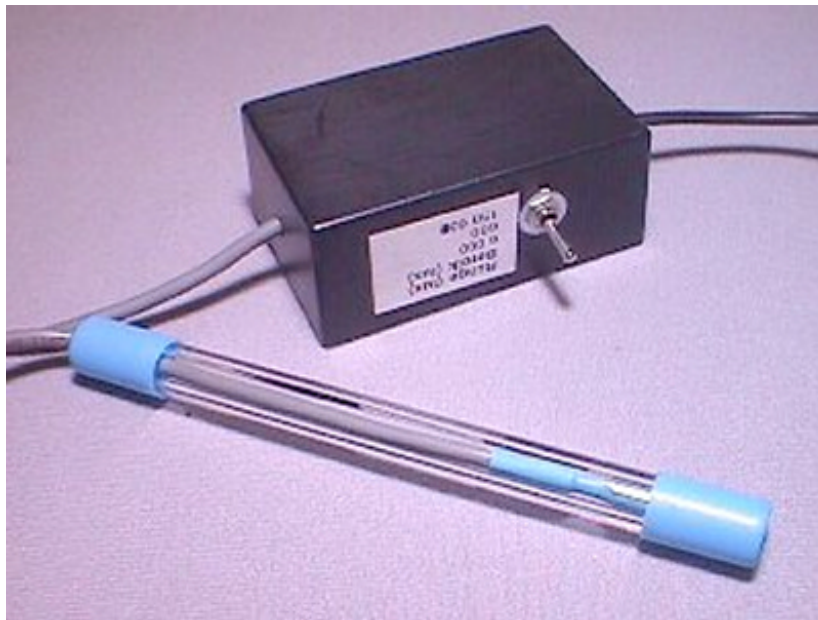


Figure 1. The Light Sensor with 3 measurement ranges

Short description

A photodiode, which is connected to the end of a transparent plastic tube, converts the measured light intensity into an electric current. The current is linear with the light intensity.

The electrical circuit in the little black box functionally consists of:

- a part which converts the current into a voltage signal;
- a part which amplifies the voltage signal.

With the switch on the black box one of the 3 measurement ranges can be selected. A larger range corresponds to a smaller amplification factor for the voltage signal. The spectral response of the sensor compares to that of the human eye. The peak sensitivity lies in the wavelength interval between 500 and 600 nm.

The block schedule of the electrical circuit is shown in figure 2.

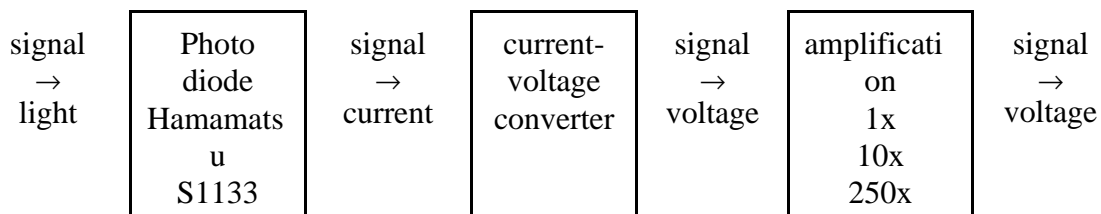


Figure 2. Block schedule of the light sensor.

The light sensor is delivered with a BT-plug and can be connected to the following interfaces:

- UIA/UIB through Measuring console (via 0520 adapter)
- CoachLab
- CoachLab II
- SMI (via 0520 adapter)
- Texas Instruments CBL™ data-logger.

There is an adapter (art. 0520) to connect sensors with BT-plugs to 4-mm inputs.

Suggestion for experiments

- Measurements of the variations in the light intensity, which can not be observed with the eye: e.g. fluctuations in the light intensity of a bulb caused by voltage fluctuations (50 Hz) and effects caused by on/off switching.
- Measurements of the discolouring of solutions.
- Light/dark transitions can be used to measure passage times:
 - measurement of displacement of a falling stick with slits or a disc with holes,
 - in titration experiments the number of drops falling from a burette can be counted.

Calibration

A calibration curve is obtained by placing different light bulbs at a distance of 1.0 m from the light sensor. Using the light bulb specifications a sensitivity of 5.8 mV/lux is found (see figure 3 and figure 4).

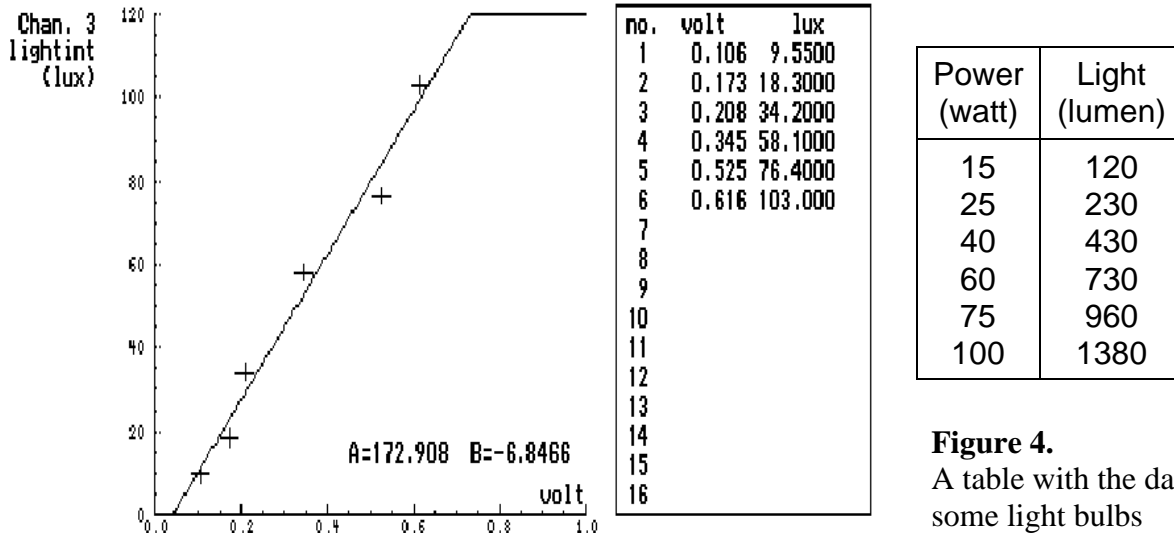


Figure 4.
A table with the data of some light bulbs

Figure 3. Calibration graph of the light sensor

The name of the light sensor in the sensor library of Coach 5 program is **Light sensor (033&bt) (CMA)**. The sensor has three calibrations between 0..600lux, between 0..6000lux, and between 0..150000lux.

Linearity of the light sensor

The linearity of the sensor has been measured by varying the distance between the sensor and a source of light. For this purpose a light bulb (100 W; 1300 lm) was used. The output voltage of the sensor is plotted versus the light intensity (which was calculated from the distance) in lm/m^2 (lux).

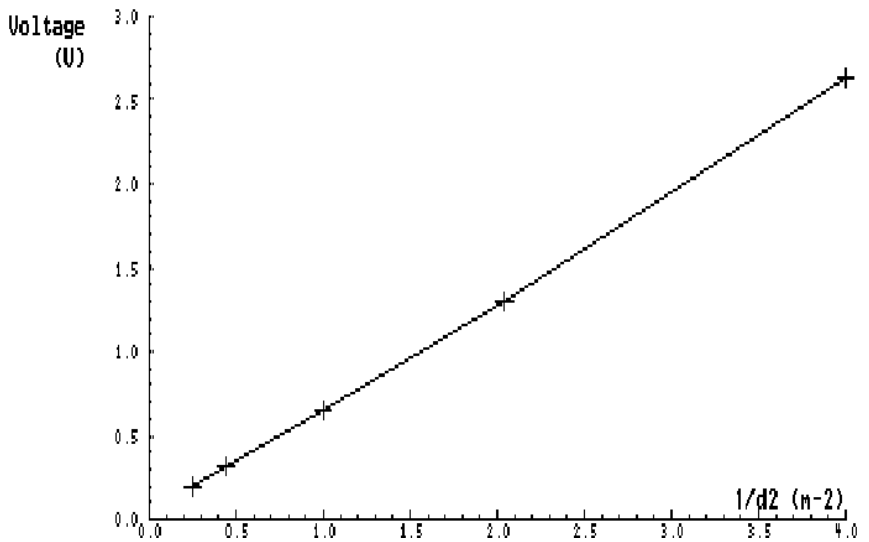


Figure 5. The sensor voltage versus the square of the reciprocal distance to the light source.

Spectral sensitivity of the sensor

The spectral sensitivity of the sensor approximates to the spectral sensitivity of the eye. The maximum sensitivity lies between 500 and 600 nm. Going towards the boundaries of the visible light area, the sensitivity of the sensor decreases less than that of the eye.

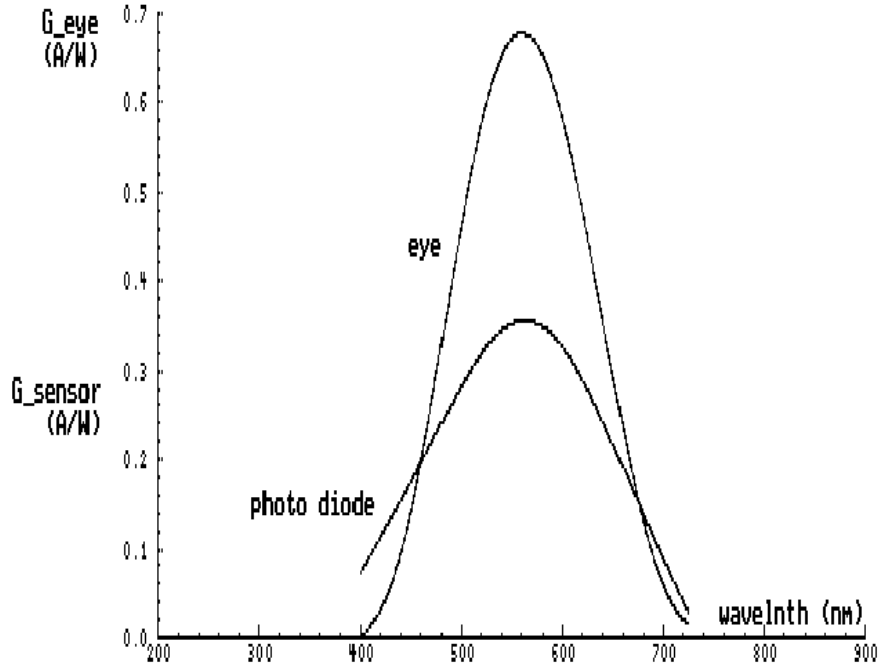



Figure 6. Spectral sensitivity of the photodiode

Technical data

Photodiode Area	Hamamatsu S1133 3 mm x 2.5 mm		
Output voltage	0 - 3V		
Light intensity ranges	0 - 600 lux	0 - 6000 lux	0 - 150000 lux
Sensitivity	5.0 mV/lux	0.45 mV/lux	0.20 mV/lux
Resolution using 12 bit 5V A/D converter	0.25 lux	2.5 lux	6 lux
Transparent tube Black box	Length = 14.7 cm; Diameter = 1.25cm Length = 8 cm; Width = 5 cm; Height = 3.5 cm		
Connection	 BT (British Telecom) plug		