

Phototransistor (light sensor)

Contents: Brightness-controlled LEDs

Phototransistor
LED + series resistor
Use of an ADC

LESSON 1

Use of a phototransistor



You have certainly noticed that the streetlamps on public squares are switched on and off depending on the ambient brightness. Such automatic circuits can be easily realised with a phototransistor.

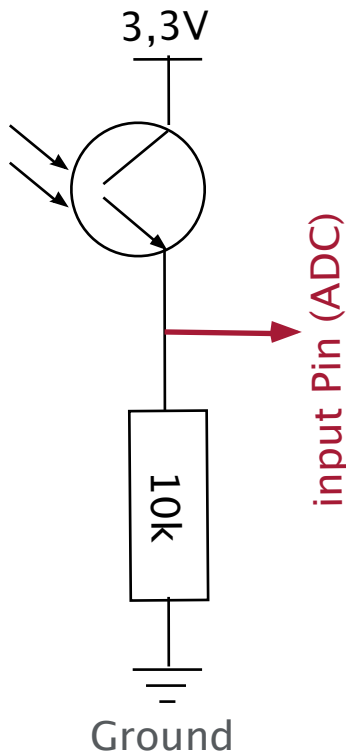
Depending on the ambient brightness, the current flow through the phototransistor is increased or reduced. This characteristic can be used to switch on a LED (in reality, it would be a streetlamp) when it becomes dark.

Use of robotics

Phototransistors are often used in robotics. Robotic vehicles follow a line to perform autonomous tasks. Differences in brightness like "black and white" surfaces are also recognised by phototransistors.

LESSON 2

Phototransistors as voltage dividers



In combination with a resistor, a voltage divider can be realised (see lesson on voltage dividers).

Info

For further information on voltage dividers, please refer to the respective worksheet.

LESSON 3

Use of an ADC

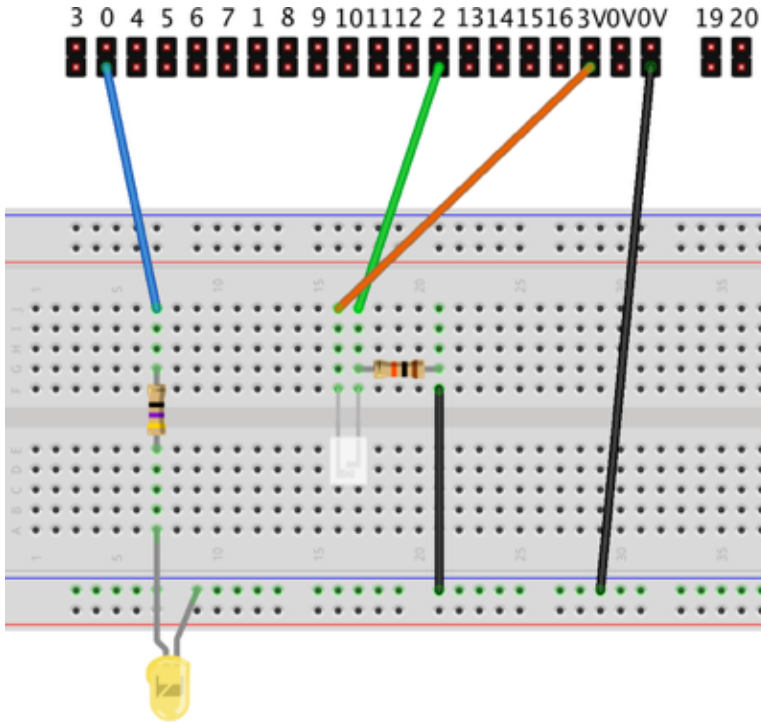
Analogue Digital Converters (ADC) are used to measure the voltage and convert it, depending on the resolution of the ADC, to a numerical value for processing in the program.

The ADC of a Micro Bit has a resolution of 10bit $\Rightarrow 2^{10} = 1024$. This means, the possible voltage range of 0V to 3.3V is divided on the numerical value range of 0 to 1023.

The voltage divider from lesson 2 provides a brightness-dependent voltage at the input pin of the Micro Bit. The higher the brightness the higher the applied voltage. This is converted by the ADC to a value between 0 and 1023. This value can now be used, for example, to switch on a streetlamp when it gets dark.

LESSON 4

Schaltungsaufbau



- Position the LED as illustrated. The long pin (anode) faces upwards to the series resistor.
- The short pin (cathode) is routed to the common Gnd (- pole).
- The long pin is routed via a series resistor (47 Ohm) to the output pin of the Micro Bit.

[Blue cable- Pin0]

- The phototransistor and resistor (10kOhm) form a voltage divider, at the centre of which the value is determined by the **ADC (pin 2)**.
- Connect the green cable from the centre of the voltage divider to pin 2.
- Afterwards, the voltage divider is supplied with 3V via the orange cable and the other end of the voltage divider is connected to the common ground bar.

[Orange cable - 3V]

- In the end, do not forget to connect the ground bar to 0V of the Micro Bit.

[Black cable - 3V]

LESSON 5

Block code of brightness-controlled LEDs

```
dauerhaft
wenn analoge Werte von Pin P2 < 700 dann
  schreibe digitalen Wert von Pin P0 auf 1
ansonsten
  schreibe digitalen Wert von Pin P0 auf 0
```

Information on block code

```
dauerhaft
wenn analoge Werte von Pin P2 < 700 dann
schreibe digitalen Wert von Pin P0 auf 1
ansonsten
schreibe digitalen Wert von Pin P0 auf 0
```

If a specific brightness value of the phototransistor is fallen below ... (recorded by ADC at pin 2)

... the LED at pin 0 is switched on.

... otherwise, the LED is off.