

# Photodiode as current source

## Student Group

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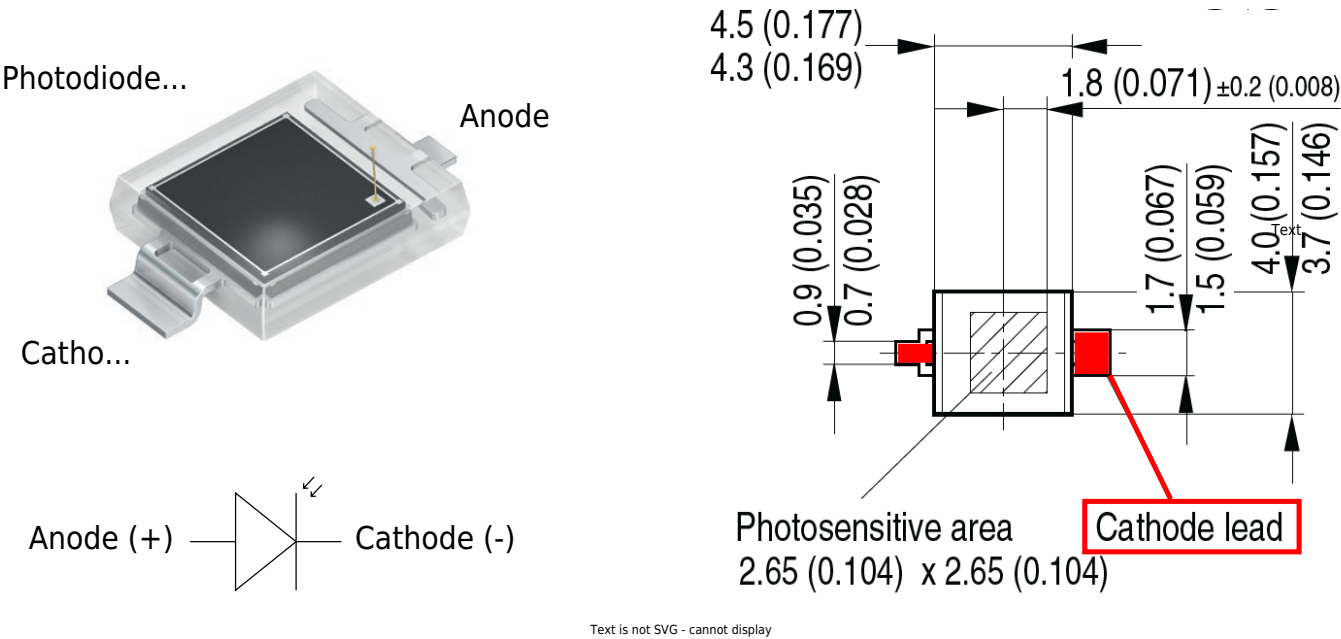


Fig. 2: Inverting Op-Amp: Photodiode BPW 34 S

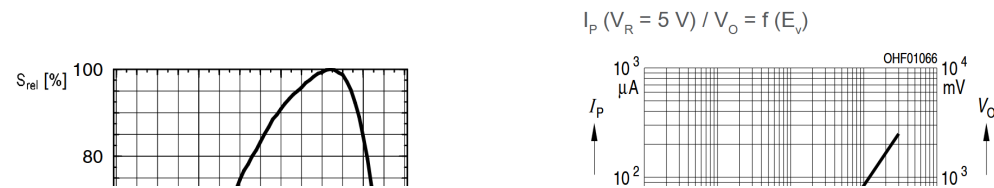


Fig. 3: Inverting Op-Amp: Diagramms of BPW 34 S

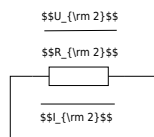


Fig. 4: Inverting Op-Amp: Photo Diode as current source

$$U_{DD} \approx 10\text{ V}, U_{SS} \approx -10\text{ V}$$

We assume a good illuminated room of 300 lx, illuminated by a white LED. White light is a mixture of many wavelengths across the visible spectrum, roughly 380 to 780 nm.

For a typical white LED, the spectrum usually comes from a blue LED chip with a peak around 450 nm, plus a broader phosphor emission that spreads across green, yellow, and red wavelengths.

For an easier calculation, we take a mean value of 500 nm which is close to the peak value of the blue LED (in reality a greenish light) and 300 lx for the illumination.

The graph in [figure 3](#) shows that the photodiode sensitivity at 500 nm is only 30%. The maximum current (100%) at 300 lx is 30  $\mu\text{A}$ .

We can now estimate the current we would expect from the photodiode at 300 lx:

$$I_1 = 30\text{ }\mu\text{A} * 0.3 = 9\text{ }\mu\text{A}$$

$$I_1 \approx 10\text{ }\mu\text{A}$$

30% of 30  $\mu\text{A}$  is roughly 10  $\mu\text{A}$ .

We will assume a current of 10  $\mu\text{A}$  at 300 lx for our calculations.

Complete the arrows in the schematic of the circuit in [figure 4](#).

Calculate  $R_2$  so that  $U_{OUT} = 5\text{ V}$  at 300 lx. Take a resistor from the E6 series that is as close as possible to the calculated value.

Also fill in the values for  $I_1$ ,  $I_2$ ,  $U_{OUT}$  and  $U_2$ .

$$I_1 \approx$$

$$I_{\text{2}} \approx$$

$$U_{\text{OUT}} \approx$$

$$U_{\text{2}} \approx$$

$$R_{\text{2}} \approx$$

What value would you expect for  $U_{\text{D}}$  and why?

$$U_{\text{D}} \approx$$

$$\{\text{rm .....}\}$$

$$\{\text{rm .....}\}$$

$$\{\text{rm .....}\}$$

$$\{\text{rm .....}\}$$

$$\{\text{rm .....}\}$$

$$\{\text{rm .....}\}$$

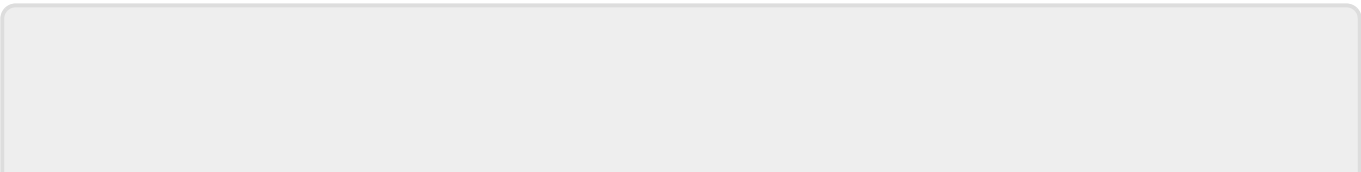
What value would you expect for  $U_{\text{D}}$  at 300 lx when it is not connected to the Op-Amp or any other electronic component (open-circuit voltage) and why?

$U_{\text{D}} \approx$

- 
- 
- 
- 
- 
- 

| Illumination | $U_{\text{OUT}}$ [...] | $I_{\text{1}}$ [ $\mu\text{A}$ ...] | $I_{\text{2}}$ [ $\mu\text{A}$ ...] | $U_{\text{D}}$ [mV...] | $U_{\text{D}}$ [mV...] |
|--------------|------------------------|-------------------------------------|-------------------------------------|------------------------|------------------------|
| dark...      |                        |                                     |                                     |                        |                        |
| 300 lx...    |                        | ...                                 |                                     |                        |                        |

Tab. 1: Photodiode measured values



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