

# 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

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

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 and 300 lx for the illumination. (500 nm is in reality a greenish light and not blue) 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:

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

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

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 enter the values for  $I_1$ ,  $I_2$ ,  $U_2$  and  $U_{OUT}$ .

$$I_1 =$$

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

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

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

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

What value would you expect for  $U_{\text{D}}$  in [figure 4](#) 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?

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

$\text{mV}$  .....

$\text{mV}$  .....

$\text{mV}$  .....

$\text{mV}$  .....

$\text{mV}$  .....

$\text{mV}$  .....

Measure or calculate the values given in the table below.

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

Tab. 1: Photodiode measured and calculated values

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