

Photodiode as current source

Student Group

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Fig. 1: Inverting Op-Amp: Photodiode BPW 34 S



Fig. 2: Inverting Op-Amp: Diagramms of BPW 34 S



Fig. 3: Inverting Op-Amp: Photo Diode as current source

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

We are assuming a well-lit room with an illuminance of 300 lx, lit 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 2 shows that the photodiode sensitivity at 500 nm is only 30%. The maximum current (100%) at 300 lx is 30 μA .

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 μA is roughly 10 μA .

We will assume a current of 10 μA at 300 lx for our calculations.

Complete the arrows in the circuit diagram in figure 3.

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} .

$$I_1 = \text{ } \mu\text{A}$$

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

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

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

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

What value would you expect for U_{D} in figure 3 and why?

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

$\{ \dots \}$

$\{ \dots \}$

$\{ \dots \}$

$\{ \dots \}$

$\{ \dots \}$

$\{ \dots \}$

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

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

.....

.....

.....

.....

.....

.....

Measure or calculate the values given in the table below.

| illumination | U_{OUT} ... | I_{1} ... | I_{2} ... | U_{D} ... | U_{D} ... |
|--------------|----------------------|--------------------|--------------------|--------------------|--------------------|
| dark... | | | | | |
| 300 lx... | | | | | |

Tab. 1: Photodiode measured and calculated values

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Last update: **2026/04/27 13:47**

