

OPT201 PHOTODIODE-AMPLIFIER REJECTS AMBIENT LIGHT

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Many applications call for the measurement of a light signal in the presence of ambient background light. Sometimes the photodiode can be optically shielded from background light to eliminate unwanted signals. Another way to solve the problem is to combine a photodiode-amplifier like the OPT201 with a DC restoration circuit to reject low-frequency background light signals.

The circuit for a photodiode amplifier with DC restoration is shown in Figure 1. The circuit uses the OPT201 integrated photodiode and amplifier and an external op amp for DC restoration. The OPT201 combines a large 0.090 x 0.090 inch photodiode and high-performance transimpedance amplifier on a single chip. This combination eliminates the problems commonly encountered in discrete designs such as leakage current errors, noise pick-up, and gain peaking due to stray capacitance.

The DC restoration circuit consists of a non-inverting integrator driving the OPT201 transimpedance amplifier summing junction through a 100kΩ resistor, R₃. The current through R₃ cancels the current from the photodiode at signal frequencies below the pole frequency of the integrator to drive the output of the OPT201 to 0V. The pole-frequency of the integrator is set by R₂ and C₂.

Integrator Pole Frequency

$$f_{-3dB} = \frac{1M}{R_3(2 \cdot \pi \cdot R_2 \cdot C_2)}$$

The component values shown in Figure 1 set the low-frequency cutoff pole at 16Hz. Because of the long time constant, it may take over a second for the OPT201 output to come out of saturation when the circuit is first powered-up.

A non-inverting integrator requires a matching pole. The matching pole, set by R₁ and C₁, prevents the OPT201 output signals above the pole frequency from feeding directly back into the summing junction of the OPT201. Matching of the poles is not critical—±30% tolerance is adequate for most applications.

The value used for R₃ depends on the amplitude of the background light. With 10V output on A₁, the 100kΩ resistor can provide 100μA restoration current to the OPT201. This is ten times the photodiode current that would otherwise drive the OPT201 to 10V output when using the internal 1MΩ resistor. The DC restoration circuit can remove a background signal many times larger than the ac signal of interest providing the increased signal-to-noise level critical in many applications. Reducing the value of R₃ will increase the DC restoration range, but will also increase the noise gain of the transimpedance amplifier. Reducing R₃ to 10kΩ would increase noise from 130μVrms to 650μVrms. Values above 100kΩ for R₃ will not substantially reduce noise.

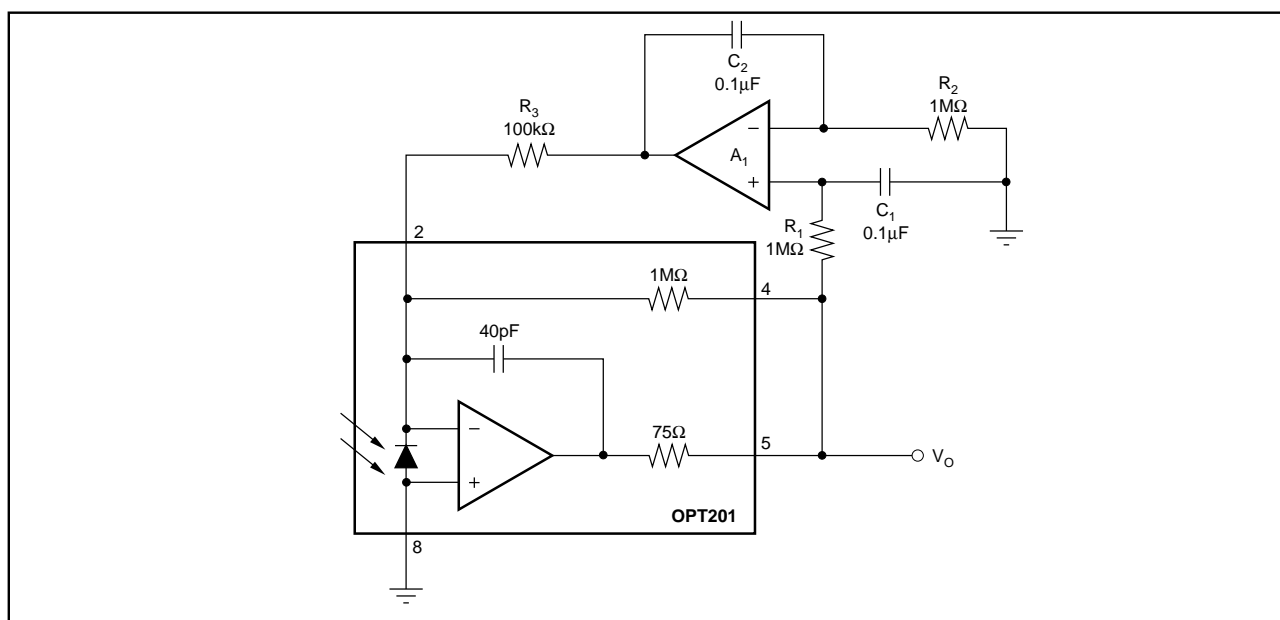


FIGURE 1. Photodiode-Amplifier with DC Restoration Rejects Unwanted Background Light.