Paralleling decreases autozero-amplifier noise by a factor of two

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Autozero amplifiers have almost zero drift and input-offset values of 1 to 20 μV. You can compensate for the initial voltage offset of an autozero amp in sensitive circuits, such as dc amplifiers and integrators, requiring the processing of voltages of 10 μV to 1 mV. Total compensation down to an offset of 0V, however, is an illusion because residual low-frequency output noise is still present in any autozero amp.

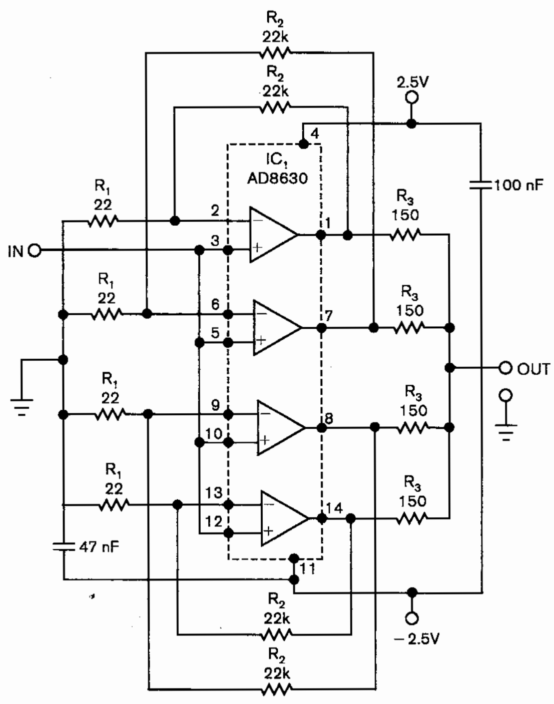

Figure 1 Use this circuit when your application requires zero drift and low output noise.

The Analog Devices (www.analog.com) AD8628 autozero amp has a low-frequency-noise value of 0.5 μV p-p at 0.1 to 10 Hz. If your application requires zero drift and low output noise, you can use the circuit in **Figure 1**. A quad autozero amp develops a gain of almost 1000. The resistor network comprising the R_3 resistors averages the output signals of these amplifiers to create the final output voltage.

The quad autozero amps are the four sections of IC_1, an Analog Devices AD8630 (**Reference 1**). Quad integrated resistors having one common lead can substitute for the four R_3 resistors. The R_1 and R_2 resistors should be high-quality, precision, film devices with 0.5% or less tolerance. The tolerance of the R_3 resistors should not exceed 1%. The basis for decreasing the circuit's noise at the output in comparison with a single amplifier of IC_1 is the principle of averaging the signals containing the same deterministic component of random noise. If you assume that the amplifiers of IC_1 represent independent or uncorrelated noise sources that obey the gaussian distribution, then the standard deviation of the average of noise outputs of these sections is:

$$\sigma_{AVE2} = \frac{\sqrt{\sigma_X^2 + \sigma_Y^2}}{2},$$

where σ_X and σ_Y are the standard deviations of noise signals at outputs of the single respective amplifiers. If $\sigma_X = \sigma_Y$—an assumption that you can make without hesitation because the op amps reside in one chip—then:

$$\sigma_{AVE2} = \frac{\sigma_X}{\sqrt{2}}.$$

If you average four amplifiers, you obtain:

$$\sigma_{AVE4} = \frac{\sigma_X}{2}.$$

If the value of output resistance of the circuit, which is about $R_3/4 \approx 38\Omega$, is too high for your application, place a voltage follower between the output terminal and the next stage. EDN

REFERENCE

1. "AD8630 Quad, Zero Drift, Single-Supply, Rail-to-Rail Operational Amplifier," Analog Devices Inc, www.analog.com/en/prod/0,2877,AD8630,00.html.