Keywords: white noise, pink noise, flicker noise, 1/f noise, low-noise op amps

APPLICATION NOTE 4527

White-Noise Generator Has No 1/f Component

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Abstract: In this noise-generator circuit, the amplifier (MAX4238) has no 1/f component in its input voltage noise. It amplifies its own input-voltage noise with a feedback network made with low-value resistors, to avoid adding noticeable 1/f noise either from the resistors or from the amplifier's input noise current.

A similar version of this article appeared in the March 20, 2008 issue of *EDN* magazine.

White-noise generators (those for which the graph of output-power density vs. frequency is flat) are useful for testing circuits that have an extended low-frequency or dc response. For frequency ranges that extend down to a few hertz or below, however, the design of white-noise generators is complicated by the presence of pink noise (also known as flicker noise, or 1/f noise).

The noise generated by a semiconductor device always has the characteristic signature of pink noise: its output power-density amplitude increases as frequency decreases, starting with a corner frequency located at tens of hertz up to a few kilohertz. Noise generated by a high-value resistor has its own 1/f component, whose value and characteristics vary with the technology used to manufacture the resistor. If, on the other hand, the resistor value is low and the device is built with low-noise technology, the noise is almost completely white (power density constant with frequency). Unfortunately, a low-value resistor also yields a low value of noise power-density amplitude, and any device introduced to amplify that level adds pink noise of its own.

You can find amplifiers whose input voltage noise includes no pink noise component, but their input current noise will have a 1/f component (which appears at the amplifier output) if the resistance seen from any amplifier input has a significant value.

In the noise-generator circuit of **Figure 1**, the amplifier (MAX4238) has no 1/f component in its input voltage noise. It amplifies its own input-voltage noise with a feedback network made with low-value resistors, to avoid adding noticeable 1/f noise either from the resistors or from the amplifier's input noise current.

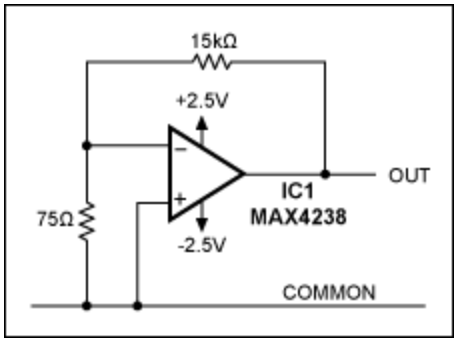

Figure 1. Built with an amplifier whose input voltage noise has no 1/f component, this white-noise generator produces an output with no 1/f component.

A plot of the circuit's output voltage as a function of frequency (**Figure 2**) is almost flat from 0.01Hz to 3kHz. The voltage-density amplitude is in the range 4-5µV/√Hz. The noise density amplitude also depends on temperature, so you should keep the circuit at constant temperature while making measurements.

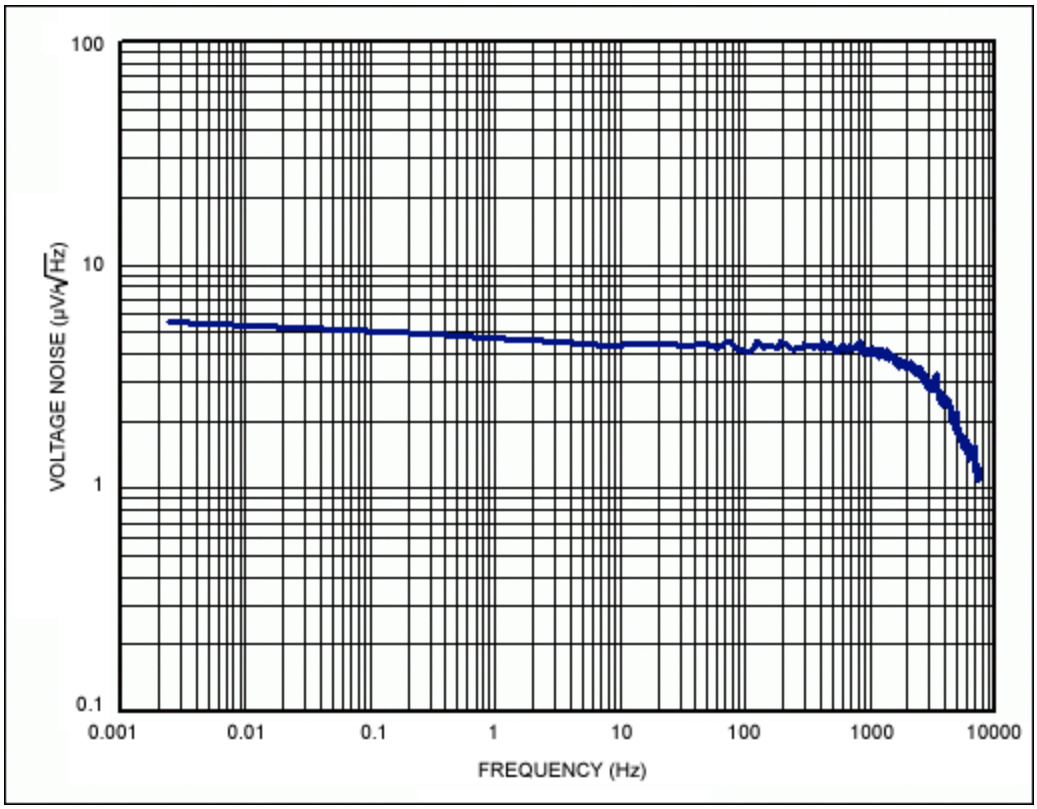

Figure 2. Output voltage noise for the Figure 1 circuit.

Related Parts		
MAX4238	Ultra-Low Offset/Drift, Low-Noise, Precision SOT23 Amplifiers	Free Samples