

Changing the op-amp for the L-4C seismometer preamp

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To get better 1 Hz performance from the L-4C seismometer, we should use the LT1001 as the first amplifier in the seismometer preamp. The noise below 10 Hz is lower, and the noise about 10 Hz is only very slightly higher.

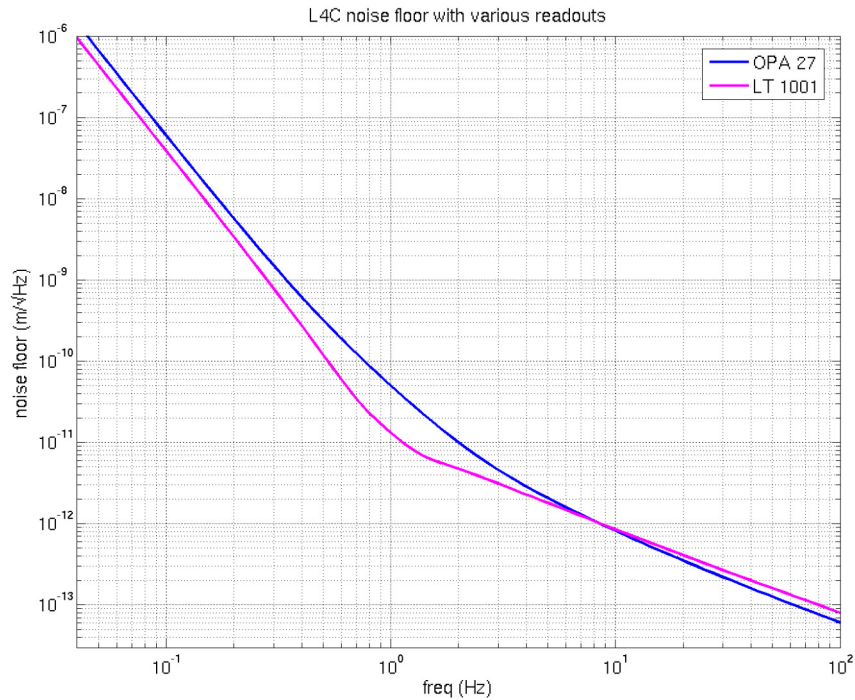


Figure 1: Comparison of the predicted performance of the L-4C seismometer with an OPA27 and a LT1001 as the readout op-amps. The LT1001 is better below 10 Hz, and the OPA 27 is slightly better above 10 Hz. Predictions are based on the manufacturer's specifications, and assume that the amplitude spectral density of the voltage and current noise each scale as $1/\sqrt{f}$ at low frequency.

These noise calculations assume that all the noise comes from the Johnson noise and the current and voltage noise of the first amplifier. The effective impedance of the L-4C is shown below in figure 2.

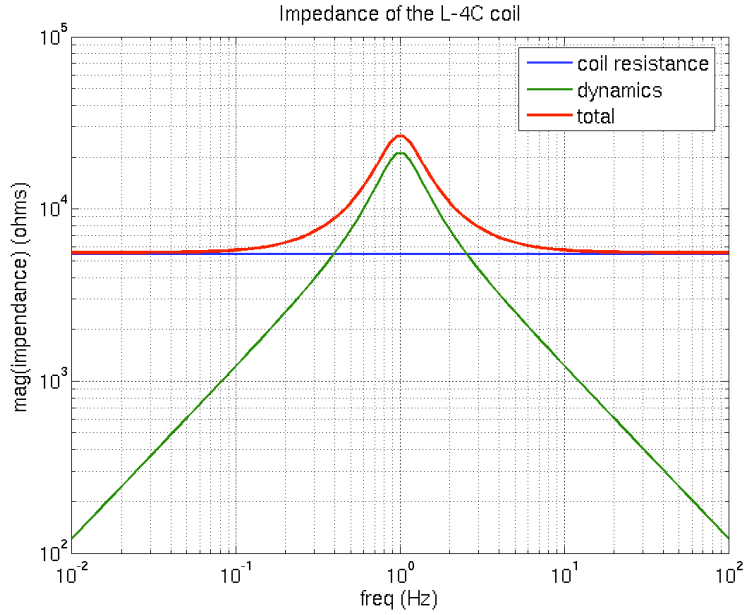


Figure 2. The impedance of the L-4C is assumed to derive from the coil resistance (5,500 ohms) plus the effect of the back EMF generated by the moving mass in the readout coil. The Johnson noise scales as the real part of the total impedance.

The individual contributions of noise from Johnson noise, op-amp voltage noise, and op-amp current noise are shown below.

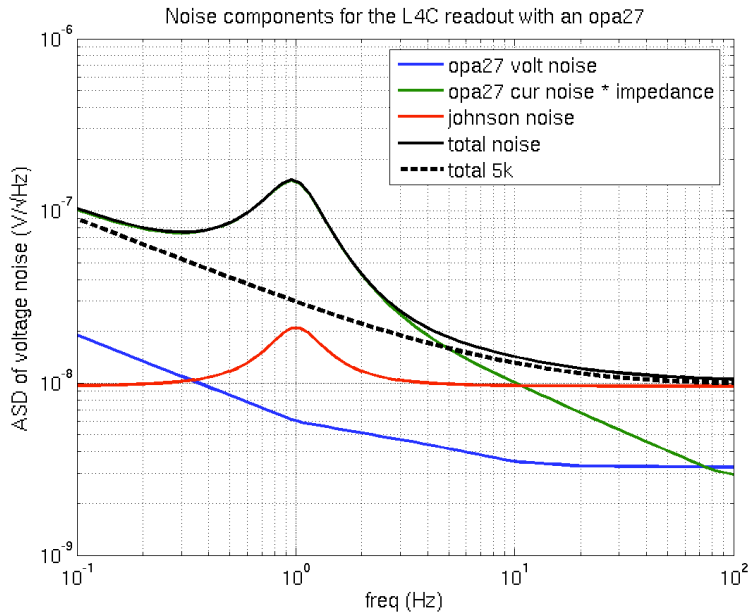


Figure 3. Noise components using an OPA 27. This is the existing amplifier. The current noise dominates the low frequency noise. The dashed line is the total noise for a purely resistive 5 kohm load.

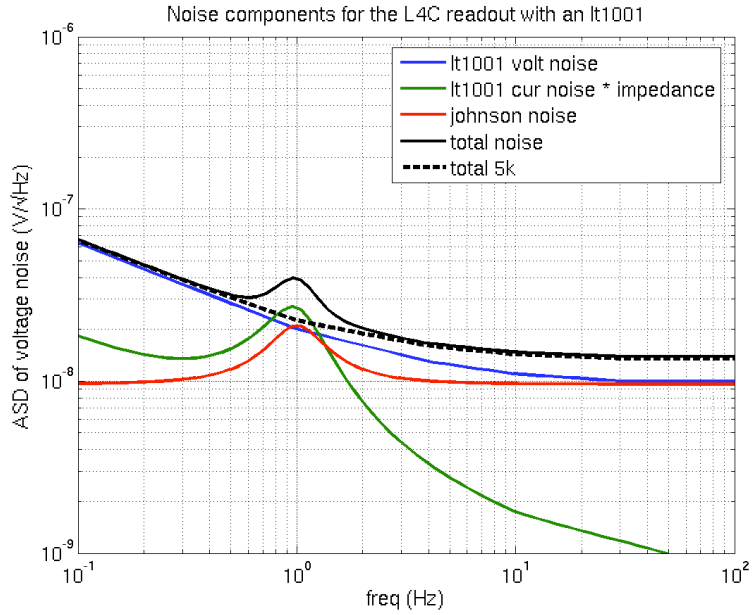


Figure 4. Noise components using an LT1001.

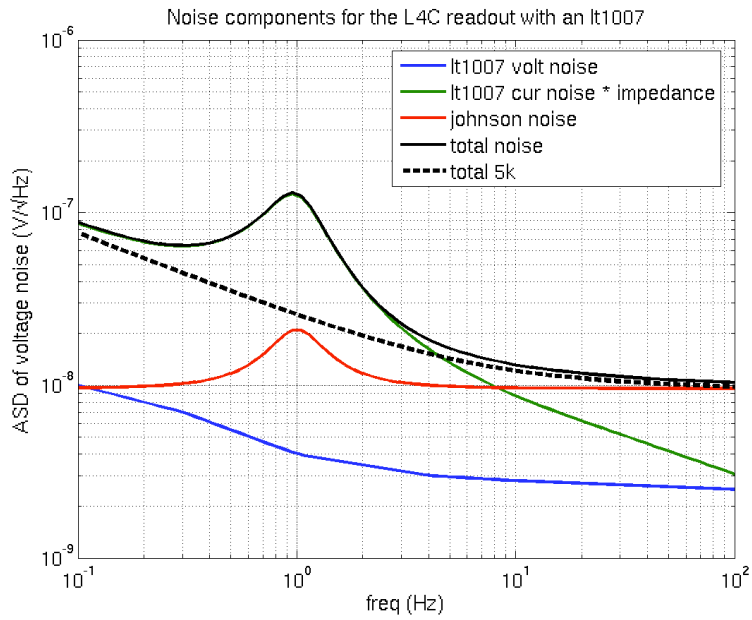


Figure 5. Noise components using an LT1007. The current noise dominates

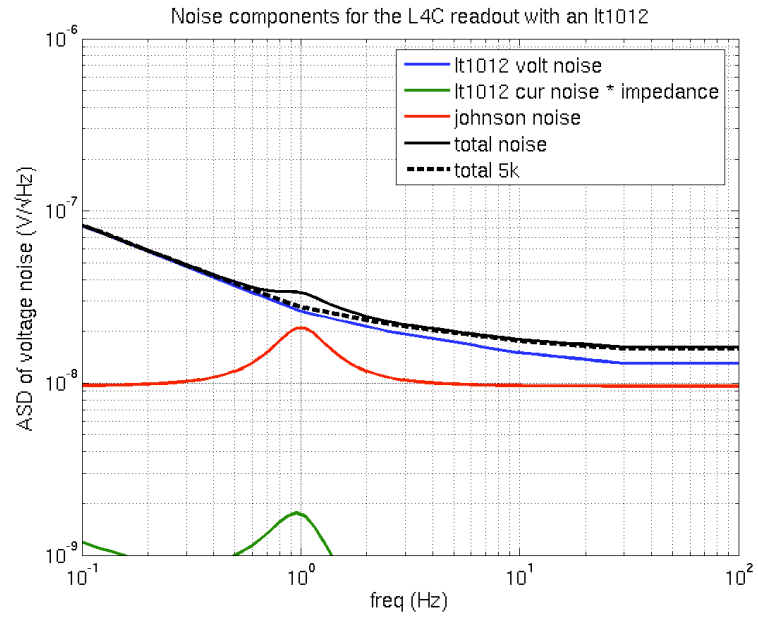


Figure 6. L-4C noise components with an LT1012. The voltage noise dominates.