Reduce Hum In Video Digitizer Circuits

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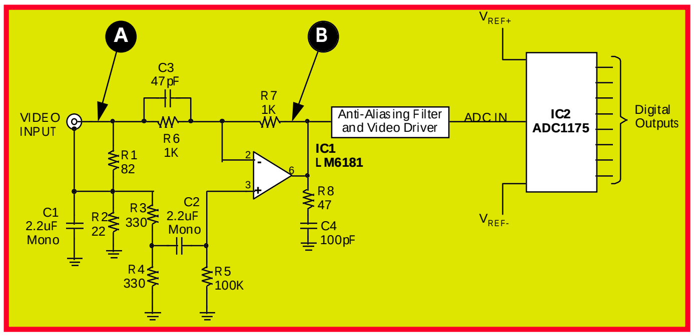
Low-frequency noise, especially hum, often is a problem in video systems. Fortunately, most hum experienced in such systems is common-mode. Hum and other low-frequency signals can be rejected by using the common-mode rejection capability of a video-rate op amp.

The simple circuit described here reduces low-frequency common-mode noise that may be present on the cable ***(Fig. 1)***. As shown, the circuit provides a nominal gain of -1.



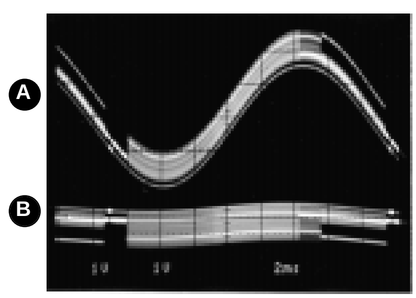
1. Low-frequency common-mode noise, particularly ac hum, present on video-system cables can be reduced with this circuit, which provides a nominal gaine of -1.

Capacitor C1 raises the cable from ground at low frequencies. C1 is a high-impedance capacitor at low frequencies when compared with the impedance of the 75-cable. Any low-frequency common-mode signal, such as hum, is presented as a common-mode signal to the difference amplifier, which will then attenuate it. This circuit will attenuate hum at about 20 dB, so that 100 mV of hum will be reduced 10 mV. The attenuation is limited primarily by the ratio accuracy of resistors R7/R6 and R4/R3. The 20 dB obtained, however, is generally more than adequate.

Capacitors C1 and C2 should be monolithic types so that they offer a low impedance at high frequencies. C3 compensates for (sin x)/x sampling losses and other frequency-response losses in the passband filtering and op-amp roll-off. R8 and C4 generate a small phase lag to increase the phase margin of op amp IC1.

The LM6181 op amp was selected for IC1 because of its high bandwidth. The ADC1175 is a low-power 20-Msample/s analog-to-digital converter with exceptional signal-to-noise ratio and total harmonic distortion performance. While this circuit isn't limited to use with this ADC, the offset range may have to be adjusted for converters with different dynamic range inputs.

Figure 2 shows the effect of the hum reduction circuit. The upper trace shows a large amount of hum at the video input, while the lower trace illustrates the signal at the output of IC1. In practice, this high level of hum is never seen, but was introduced here so that some hum is evident at the output. Also, hum, having many frequency components, is never purely sinusoidal. This circuit has been shown to reject common-mode signals of up to hundreds of kilohertz, effectively eliminating all harmful common-mode hum and noise signals.



2. Shown is the effect of the hum-reduction circuit: The upper trace indicates a large amount of hum at the video input; the lower trace shows the signal at the output of op amp IC1.

The circuit performance is exceptional, with signal-to-noise ratio readings in the 44-dB range and total harmonic distortion in the -62-dB range. This performance is essentially that of the ADC1175.