APPLICATIONS

BASIC GAIN CIRCUITS

The gain of the AD8129/AD8130 can be set with a pair of feedback resistors. The basic configuration is shown in Figure 132. The gain equation is the same as that of a conventional op amp: $G = 1 + R_F/R_G$. For unity-gain applications using the AD8130, R_F can be set to 0 (short circuit), and R_G can be removed (see Figure 133). The AD8129 is compensated to operate at gains of 10 and higher; therefore, shorting the feedback path to obtain unity gain causes oscillation.

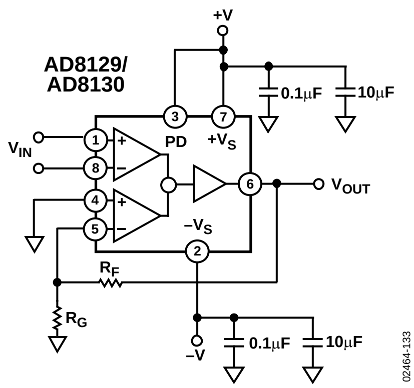

Figure 132. Basic Gain Circuit: $V_{OUT} = V_{IN}(1 + R_F/R_G)$

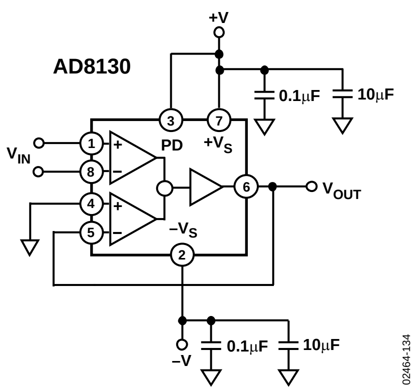

Figure 133. An AD8130 with Unity Gain

The input signal can be applied either differentially or in a single-ended fashion—all that matters is the magnitude of the differential signal between the two inputs. For single-ended input applications, applying the signal to the +IN with −IN grounded creates a noninverting gain, while reversing these connections creates an inverting gain. Because the two inputs are high impedance and matched, both of these conditions provide the same high input impedance. Thus, an advantage of the active feedback architecture is the ability to make a high input impedance inverting op amp. If conventional op amps are used, a high impedance buffer followed by an inverting stage is needed. This requires two op amps.

TWISTED-PAIR CABLE, COMPOSITE VIDEO RECEIVER WITH EQUALIZATION USING AN AD8130

The AD8130 has excellent common-mode rejection at its inputs. This makes it an ideal candidate for a receiver for signals that are transmitted over long distances on twisted-pair cables. Category 5 cables are very common in office settings and are extensively used for data transmission. These cables can also be used for the analog transmission of signals such as video.

These long cables pick up noise from the environment they pass through. This noise does not favor one conductor over another and therefore is a common-mode signal. A receiver that rejects the common-mode signal on the cable can greatly enhance the signal-to-noise ratio performance of the link.

The AD8130 is also very easy to use as a differential receiver, because the differential inputs and the feedback inputs are entirely separate. This means that there is no interaction between the feedback network and the termination network, as there would be in conventional op amp types of receivers.

Another issue with long cables is that there is more attenuation of the signal at longer distances. Attenuation is also a function of frequency; it increases to roughly the square root of frequency.

For good fidelity of video circuits, the overall frequency response of the transmission channel should be flat vs. frequency. Because the cable attenuates the high frequencies, a frequency-selective boost circuit can be used to undo this effect. These circuits are called equalizers.

An equalizer uses frequency-dependent elements (Ls and Cs) to create a frequency response that is the opposite of the rest of the channel's response to create an overall flat response. There are many ways to create such circuits, but a common technique is to put the frequency-selective elements in the feedback path of an op amp circuit. The AD8130 in particular makes this easier than other circuits, because, once again, the feedback path is completely independent of the input path and there is no interaction.

The circuit in Figure 134 was developed as a receiver/equalizer for transmitting composite video over 300 meters of Category 5 cable. This cable has an attenuation of approximately 20 dB at 10 MHz for 300 meters. At 100 MHz, the attenuation is approximately 60 dB (see Figure 135).

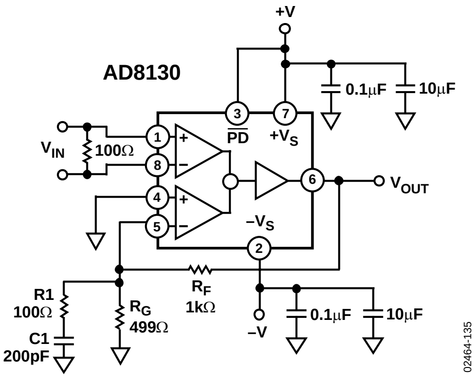

Figure 134. An Equalizer Circuit for Composite Video Transmissions over 300 Meters of Category-5 Cable

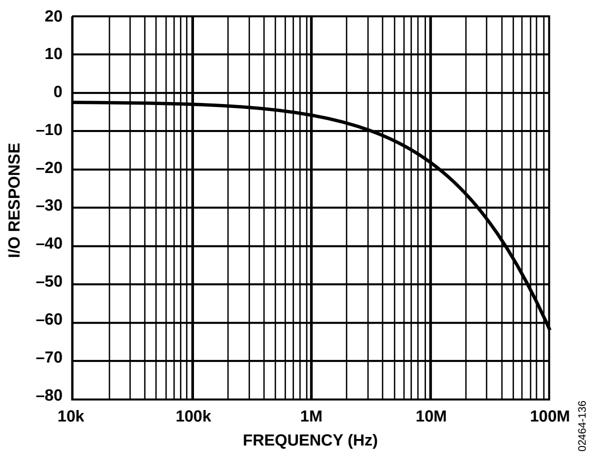

Figure 135. Transmission Response of 300 Meters of Category-5 Cable

The feedback network is between Pin 6 and Pin 5 and from Pin 5 to ground. C1 and R_F create a corner frequency of about 800 kHz. The gain increases to provide about 15 dB of boost at 8 MHz. The response of this circuit is shown in Figure 136.

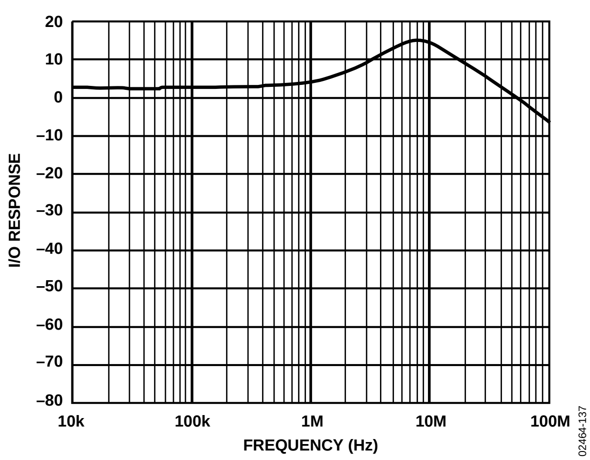

Figure 136. Frequency Response of Equalizer Circuit

It is difficult to calculate the exact component values via strictly mathematical means, because the equations for the cable attenuation are approximate and have functions that are not simply related to the responses of RC networks. The method used in this design was to approximate the required response via graphical means from the frequency response and then select components that would approximate this response. The circuit was then built, measured, and finally adjusted to obtain an acceptable response—in this case, flat to 9 MHz to within approximately 1 dB (see Figure 137).

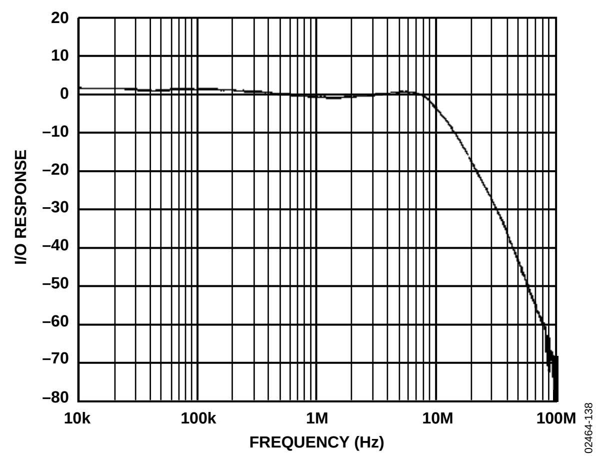

Figure 137. Combined Response of Cable Plus Equalizer

OUTPUT OFFSET/LEVEL TRANSLATOR

The circuit in Figure 133 has the reference input (Pin 4) tied to ground, which produces a ground-referenced output signal. If it is desired to offset the output voltage from ground, the REF input can be used (see Figure 138). The level V_{OFFSET} appears at the output with unity gain.

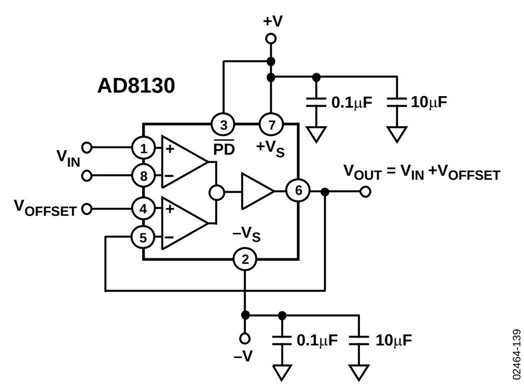

Figure 138. The Voltage Applied to Pin 4 to the Unity-Gain Output Voltage Produced by V_{IN}

If the circuit has a gain higher than unity, the gain must be factored in. If R_G is connected to ground, the voltage applied to REF is multiplied by the gain of the circuit and appears at the output—just like a noninverting conventional op amp. This situation is not always desirable; the user may want V_{OFFSET} to appear at the output with unity gain.