APPLICATIONS INFORMATION

Amplifier Characteristics

Figure 1 is a simplified schematic of the amplifier, which has a pair of low noise input transistors M1 and M2. A simple folded cascode Q1, Q2 and R1, R2 allow the input stage to swing to the negative rail, while performing level shift to the differential drive generator. Low offset voltage is accomplished by laser trimming the input stage.

Capacitor C1 reduces the unity cross frequency and improves the frequency stability without degrading the gain bandwidth of the amplifier. Capacitor CM sets the overall amplifier gain bandwidth. The differential drive generator supplies signals to transistors M3 and M4 that swing the output from rail-to-rail.

The photo of Figure 2 shows the output response to an input overdrive with the amplifier connected as a voltage follower. If the negative going input signal is less than a diode drop below V^-, no phase inversion occurs. For input signals greater than a diode drop below V^-, limit the current to 3mA with a series resistor R_S to avoid phase inversion.

ESD

The LTC6240/LTC6241/LTC6242 have reverse-biased ESD protection diodes on all input and outputs as shown in Figure 1. If these pins are forced beyond either supply, unlimited current will flow through these diodes. If the current is transient and limited to one hundred milliamps or less, no damage to the device will occur.

The amplifier input bias current is the leakage current of these ESD diodes. This leakage is a function of the temperature and common mode voltage of the amplifier, as shown in the Typical Performance Characteristics curves.

Noise

The LTC6240/LTC6241/LTC6242 exhibit exceptionally low 1/f noise in the 0.1Hz to 10Hz region. This $550nV_{P-P}$ noise allows these op amps to be used in a wide variety of high impedance low frequency applications, where zero-drift amplifiers might be inappropriate due to their charge injection.

In the frequency region above 1kHz the LTC6240/LTC6241/LTC6242 also show good noise voltage performance. In this frequency region, noise can easily be dominated by the total source resistance of the particular application. Specifically, these amplifiers exhibit the noise of a 3.1kΩ resistor, meaning it is desirable to keep the source and feedback resistance at or below this value, i.e. $R_S + R_G||R_{FB} \le 3.1k\Omega$. Above this total source impedance, the noise voltage is not dominated by the amplifier.

Noise current can be estimated from the expression $i_n = \sqrt{2qI_B}$, where $q = 1.6 \bullet 10^{-19}$ coulombs. Equating $\sqrt{4kTR\Delta f}$ and $R\sqrt{2qI_B\Delta f}$ shows that for source resistors below 50GΩ the amplifier noise is dominated by the source resistance. See the Typical Performance Characteristics curve Noise Current vs Frequency.

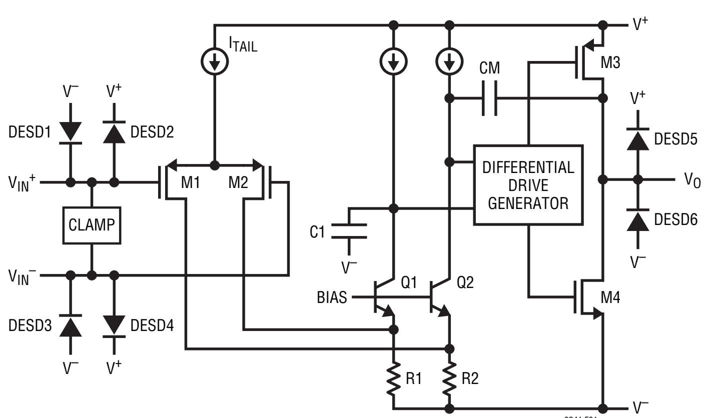
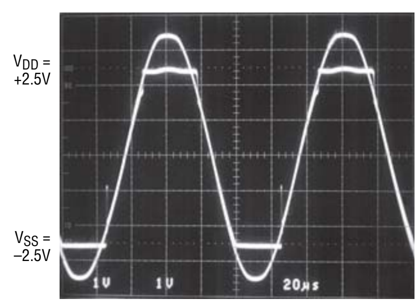


Figure 1. Simplified Schematic



V_{OUT} AND V_{IN} OF FOLLOWER WITH LARGE INPUT OVERDRIVE

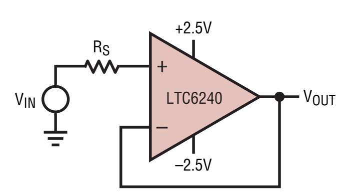


Figure 2. Unity Gain Follower Test Circuit