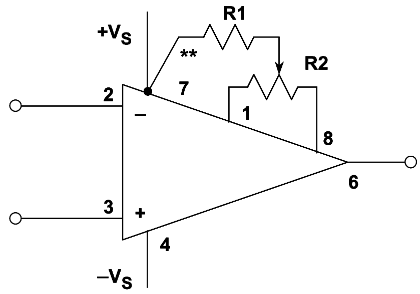
Offset Adjustment (Internal Method)

Many single op amps have pins available for optional offset null. To make use of this feature, two pins are joined by a potentiometer, and the wiper goes to one of the supplies through a resistor, as shown generally in Figure 1-40 below. Note that if the wiper is accidentally connected to the wrong supply, the op amp will probably be destroyed— this is a common problem, when one op amp type is replaced by another. The range of offset adjustment in a well-designed op amp is no more than two or three times the maximum V_{OS} of the lowest grade device, in order to minimize sensitivity. Nevertheless, the voltage gain of an op amp at its offset adjustment pins may actually be greater than the gain at its signal inputs! It is therefore very important to keep these pins noise-free. Note that it is *never* advisable to use long leads from an op amp to a remote nulling potentiometer.



- ** Wiper connection may be to either $+V_S$ or $–V_S$ depending on op amp
- R values depend on op amp. Consult data sheet
- Use to null out input offset voltage, not system offsets!
- There may be high gain from offset pins to output — Keep them quiet!
- Nulling offset causes increase in offset temperature coefficient, approximately 4µV/°C for 1mV offset null for FET inputs

Figure 1-40: *Offset adjustment pins*

As was mentioned above, the offset drift of an op amp with temperature will vary with the setting of its offset adjustment. The internal adjustment terminals should therefore be used only to adjust the op amp's own offset, *not to correct any system offset errors*, since doing so would be at the expense of increased temperature drift. The drift penalty for a FET input op amp is in the order of 4µV/°C for each millivolt of nulled offset voltage. It is generally better to control offset voltage by proper device/grade selection.

Offset Adjustment (External Methods)

If an op amp doesn't have offset adjustment pins (popular duals and all quads do not), and it is still necessary to adjust the amplifier and system offsets, an external method can be used. This method is also most useful if the offset adjustment is to be done with a system programmable voltage, such as a DAC.

With an inverting op amp configuration, injecting current into the inverting input is the simplest method, as shown in Figure 1-41A (opposite). The disadvantage of this method is that there is some increase in noise gain possible, due to the parallel path of R3 and the potentiometer resistance. The resulting increase in noise gain may be reduced by making $\pm V_R$ large enough so that the R3 value is much greater than R1||R2. Note that if the power supplies are stable and noise-free, they can be used as $\pm V_R$.

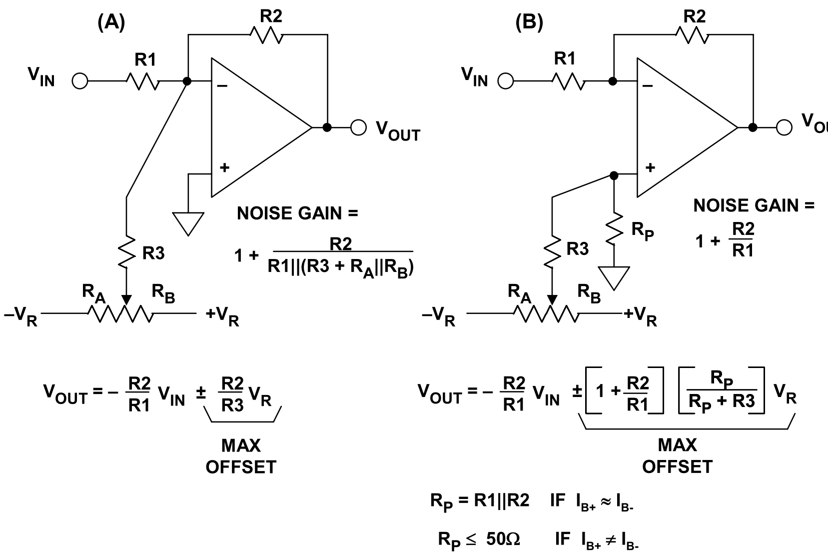


Figure 1-41: *Inverting op amp external offset trim methods*

Fig. 1-41B shows how to implement offset trim by injecting a small offset voltage into the non-inverting input. This circuit is preferred over 1-41A, as it results in no noise gain increase (but it requires adding R_P). If the op amp has matched input bias currents, then R_P should equal R1|| R2 (to minimize the added offset voltage). Otherwise, R_P should be less than 50Ω. For higher values, it may be advisable to bypass R_P at high frequencies.

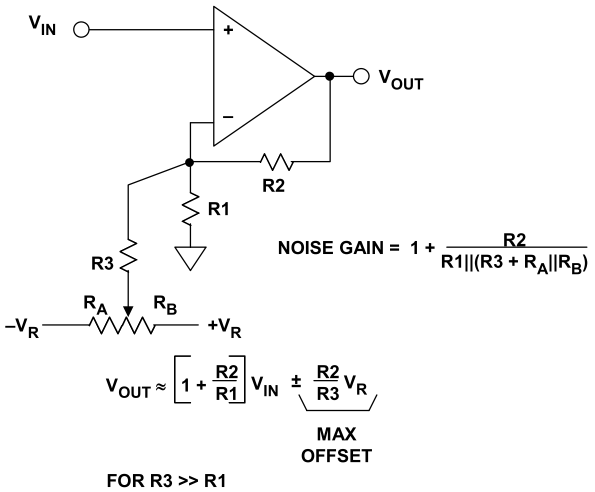


Figure 1-42: *Non-inverting op amp external offset trim methods*

The circuit shown in Figure 1-42 above can be used to inject a small offset voltage when using an op amp in the non-inverting mode. This circuit works well for small offsets, where R3 can be made much greater than R1. Note that otherwise, the signal gain might be affected as the offset potentiometer is adjusted. The gain may be stabilized, however, if R3 is connected to a fixed low impedance reference voltage sources, $\pm V_R$.