As is true in the case of the two op amp in-amp configuration, single supply operation of the three op amp in-amp requires an understanding of the internal node voltages. Figure 2-14 below shows a generalized diagram of the in-amp operating on a single +5V supply. The maximum and minimum allowable output voltages of the individual op amps are designated $V_{OH}$ (maximum high output) and $V_{OL}$ (minimum low output) respectively.

Note that the gain from the common mode voltage to the outputs of A1 and A2 is unity. It can be stated that the sum of the common mode voltage and the signal voltage at these outputs must fall within the amplifier output voltage range. Obviously this configuration cannot handle input common mode voltages of either zero volts or +5V, because of saturation of A1 and A2. As in the case of the two op amp in-amp, the output reference is positioned halfway between $V_{OH}$ and $V_{OL}$ to allow for bipolar differential input signals.

![Figure 2-14: Three op amp in-amp single +5V supply restrictions](image)

While there are a number of good single-supply in-amps, such as the AD627 discussed above, the highest performance devices are still among those specified for traditional dual-supply operation, i.e., the just-discussed AD620. For certain applications, even such devices as the AD620, which has been designed for dual supply operation, can be used with full precision on a single-supply power system.

**Precision Single-Supply Composite In-Amp**

One way to achieve both high precision and single-supply operation takes advantage of the fact that many popular sensors (e.g. strain gauges) provide an output signal which is inherently centered around an approximate mid-point of the supply voltage (and/or the reference voltage). Taking advantage of this basic point allows the inputs of a signal conditioning in-amp to be biased at "mid-supply". As a consequence of this step, the inputs needn't operate near ground or the positive supply voltage, and the in-amp can still be used with all its precision.