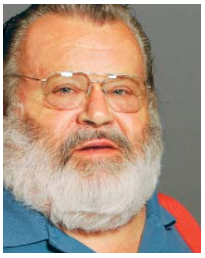

BY RON MANCINI

Anatomy of a current-feedback op amp

A previous column dealt with the VFOA (voltage-feedback op amp, **Reference 1**). This column explains the CFOA (current-feedback op amp) and includes a performance analysis.

Slew rate and frequency performance are the CFOA's strong points, but its precision and CMRR (common-mode-rejection ratio) are subpar to those of a VFOA's. **Figure 1** shows a CFOA, and circuit analysis explains these conclusions.

The V_P input has a high impedance because it connects to the input of a voltage buffer. The V_N input has a low impedance because it connects to the output of the same buffer. One immediately obvious difference between a CFOA and a VFOA is that the VFOA has matched high-input impedance, and the CFOA's input impedances differ in value. Input-stage precision requires matching, and the CFOA requires that the manufacturer match two NPN and two PNP transistors operating at different current levels. Normally, there is no way to match the input and the output stage of a buffer; thus, you don't gain precision from matching. Furthermore, few high-frequency-amplifier designs require high precision, because the signals are ac-coupled or small, or they contain no information in the dc content. This amplifier has transimpedance resulting from the current mirror rather than gain, like the VFOA. The transimpedance performs the same function as gain; hence, the precision must come from dividing the transimpedance into the error term. And, although that step can result in millivolt input-offset voltages, it seldom achieves microvolt input-offset voltages.

The most common operating mode for a CFOA is as a noninverting amplifier, because the inverting input impedance is low. You can use the CFOA as a differential amplifier, but this mode yields poor CMRR, because the input-voltage offset and input impedances do not match well. The CFOA yields poor precision and poor CMRR; thus, it finds use in applications that don't require these characteristics.

The CFOA is essentially two current buffers separated by a current mirror. Current buffers are fast, and current mirrors are reasonably fast, so the CFOA is a high-speed device with high gain bandwidth. The slew rate is not internally limited in a CFOA, because the current available to charge C_C is not limited. When the input-voltage swing is large, it forces large currents into the current mirrors, and an increasing portion of the mirror current is available to enhance the slew rate. An additional feature that enhances slew rate is the input current that can flow from the V_N input, through the feedback resistor, and into the load. The input buffer is fast, so the feedback current is almost instantaneous, causing an initial high slew rate. **Table 1** summarizes the final comparison. EDN

TABLE 1 COMPARISON OF VFOAs AND CFOAs

Parameter	VFOA	CFOA
Input impedance	Matched, high	Mismatched
Precision	Very high	Medium
CMR	Very high	Medium
Bandwidth	Medium high	Very high
Slew rate	Medium	Very high
AC error	Medium	Low

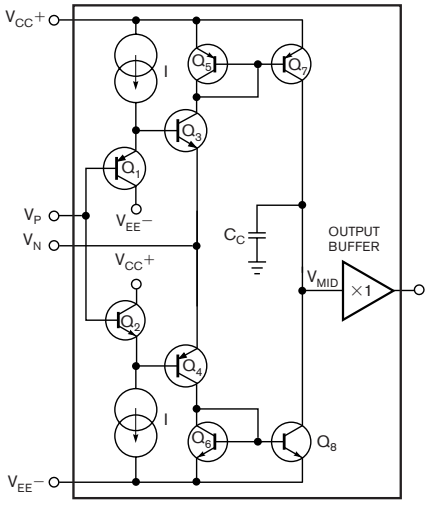

Figure 1 Connecting the CFOA inputs to a buffer input/output precludes precision.

REFERENCE

1 Mancini, Ron, "Anatomy of a voltage-feedback op amp," *EDN*, Oct 27, 2005, pg 40, www.edn.com/article/CA6275426.

MORE AT EDN.COM

Go to www.edn.com/051205rm and click on Feedback Loop to post a comment on this column.

NOTE FROM THE AUTHOR

I am retiring from Texas Instruments after a prosperous, interesting, and rewarding career. This is my last regular column for EDN. *I wish you all well; I hope you have enjoyed reading these columns as much as I have enjoyed writing them.*